Volume 22, Number 22, November 30, 1968

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director, Published by the USAEC Divison of Technical Information Extension, Robert L. Shannon, Extension Manager.

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All documents abstracted are indexed by subjects and personal authors. Technical report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summary below:

Index References

All index entries refer the reader to volume and abstract number:

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FOURRIER, Alain
  Radioactive chain of mass nueber 189,  21:10023
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Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

```
MONTH, M.
  Theory of gradient perturbations in AGS,  21:9872 (BNL-
    10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic
    form factors of the deuteron,  21:9744
```

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

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SHEEP
  radiation dosimetry in, measurement of lethal dose of x,
    21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x,
    21:8905(R) (AD-631189)
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SHELTERS
  construction of, for civil defense,  21:8838
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  determination of configuration of, for ventilation,
    21:8779(R) (AD-629928)
  equipment for fallout, minimal requirements of,
    21:8782(R) (AD-631424)
  evaluation of fallout, for fire and air blast damage,
    21:8560 (URS-658-3)
  fire resistance of components of, evaluation of,
    21:8789(R) (AD-642241)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

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UNION CARBIDE CORP., OAK RIDGE, TENN.  Y-12 PLANT.
  Mixing and sampling enriched 235U fluids in cylindrical
    storage containers,  21:8500 (Y-1561)
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Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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TID-
  3311(Suppl.  21-8567   Dep. mn. CFSTI $3.00 cy, $0.65 mn
    2)
  22298        21-9915   Nucl. News, 9: No. 12, 17-21 (Dec.
                           1966)
  22298        21-9914   Nucl. News, 10: No. 1, 17-20(Jan.
                           1967)
  23267        21-9702   Phys. Rev., 152: 1171-82(Dec. 23,
                           1966)
  23287        21-8498   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23420        21-8764   Lancet, 2: 672-5(Sept. 24, 1966)
  23474        21-8528   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23478        21-8641   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23482        21-9471   Dep. mn. CFSTI $3.00 cy, $0.65 mn
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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 47112, 47312, 47313, 47400, and 48650.

47070 (BMI-X-525) FEASIBILITY OF THE LASER MICROPROBE FOR RAPID AND ECONOMIC URANIUM ISOTOPIC ANALYSIS. Summary Report. Morris, Philip L.; Askey, Daniel F.; Pardue, William M. (Battelle Memorial Inst., Columbus, Ohio). Sept. 15, 1968. Contract W-7405-eng-92. 20p. Dep. CFSTI.

The feasibility of determining the isotopic content of uranium by a laser microprobe-emission spectrograph method was demonstrated. Uranium metal samples of varying isotopic composition from 0.04 to 93% ^{235}U were analyzed by the laser microprobe. Process parameters were defined and working curves correlating spectral line intensity ratio to ^{235}U concentration were established for samples with ^{235}U contents from 12 to 93%. Additional experiments performed to define the reproducibility of the data obtained with the relatively unsophisticated apparatus yielded values that were consistent within about ±5%. (auth)

47071 (CEA-Bib-80) METHODS OF EXTRACTION, SEPARATION, AND MEASUREMENT OF STRONTIUM IN SOILS. Saas, Arsene; Genevey, Claude; Grauby, Andre (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). May 1968. 73p. (In French). Dep.

A systematic review is given of methods used for the extraction, separation, and determination of strontium. Particular stress is laid on the extractions and separations. Three methods are proposed. Separation of calcium and strontium is carried out by paper chromatography using ethanol and ammonium nitrate with sodium rhodizonate as developer. An electrophoretic separation of strontium and yttrium is carried out using a fulvic acid extract made from the soil and the amount determined by autoradiography. A selective precipitation method for strontium using glycocol in the sulfated form is described. (auth)

47072 (CEA-R-3492) USE OF CELLULOSE ESTER FILTERING MEMBRANES IN THE DETERMINATION OF PLUTONIUM IN URINE. Harduin, Jean-Claude; Montels, Paul (Commissariat a l'Energie Atomique, la Hague (France)). Apr. 1968. 6p. (In French). Dep.

During the last stage of the determination of plutonium in biological media, cellulose ester filtering membranes are used for collecting, with the help of a special device, the very fine precipitate resulting from the coprecipitation of plutonium and lanthanum fluorides. The membranes are then dried and stuck onto flat watch glasses for α counting. A method is then given for purifying the lanthanum so as to keep the background noise during counting as low as possible. (auth)

47073 (CONF-680506-2) INVENTORY VERIFICATION AT AN AEC-OWNED CONTRACTOR SITE. Stout, Richard B. (Richland Operations Office (AEC), Wash.). May 15, 1968. 12p. Dep. CFSTI.

From 9th Annual Meeting of the Institute of Nuclear Materials Management, Chicago, Ill.

Activities conducted to obtain an independent verification of an SS materials inventory in the Chemical Processing and Plutonium Finishing facilities at Richland are described. The procedures to assure a complete and accurate inventory of all SS materials, together with a description of the independent inventory tests conducted are included. The independent inventory tests consisted of: neutron multiplication methods to verify plutonium content and isotopic composition in product buttons; single and multichannel analyzers for checking plutonium content in plutonium nitrate solution; and neutron counting of waste cartons to determine plutonium content. (auth)

47074 (IN-1215) BURNUP DETERMINATION OF NUCLEAR FUELS. Project Report for the Quarter, January 1–March 31, 1968. Lisman, Frederick L.; Maeck, William J.; Rein, James E. (Idaho Nuclear Corp., Idaho Falls). Aug. 1968. Contract AT(10-1)-1230. 28p. Dep. CFSTI.

In a continuing program to develop methods for the accurate determination of the burnup of nuclear fuels, the main emphasis was the measurement of the thermal fission yields of many stable and long-lived fission products of Pu-241. The main measurement technique was isotope dilution mass spectrometry. The determined thermal fission yields relative to ^{148}Nd and the calculated absolute fission yields are given. (auth)

47075 (LA-DC-9848) APPLICATIONS OF NEUTRON INTERROGATION TO ASSAY OF FISSIONABLE MATERIAL. Thorpe, M. M.; Henry, C. N.; Smith, Darryl B.; Menlove, H. O.; Augustson, R. H. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 5p. (CONF-681101-1). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

The delayed neutron response technique of assay was applied to cold, clean MTR fuel elements. The resulting measured isotopic abundance agreed with the actual isotopic abundance to within 1%. Calculation indicated that barrels containing almost any common scrap material, other than hydrogenous material, are essentially "transparent" to 14-MeV neutrons. (M.C.G.)

47076 (NEIC-RR-32) ISOTOPIC AND ELEMENTAL COMPOSITION OF METEORITES. A Bibliography: 1947–1967. Kielbasinski, J.; Wanat, L. (comps.) (Nuclear Energy Information Center, Warsaw (Poland)). 1968. 133p. Dep.

One thousand and eighteen references to papers published in the years 1947-1967 are presented. They are arranged chronologically according to year, and within a year they are ordered alphabetically according to the name of the first author. A subject index was completed on the basis of the titles of the papers. (M.C.G.)

47077 (NYO-844-75) NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH. Progress Report, 1967–1968. Kohman, Truman P. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry). July 31, 1968. Contract AT(30-1)-844. 83p. Dep. CFSTI.

Research is reported on: Cd abundances in tektites, Moessbauer spectroscopy of iron in coal, alpha spectra of U in tektites, isotopic composition of Tl in meteorites, Hg and Bi abundances in iron meteorites, gamma-gamma coincidence spectrometer, determination of Tl and Pb in meteorites, natural radioactivity of ^{40}Ca, and counting systems. (M.C.G.)

47078 (TRG-Report-962(Rev.1)) ANALYTICAL METHOD FOR THE DETERMINATION OF ^{137}Cs IN FISSION PRODUCT SOLUTIONS USING A CARRIER-FREE EXTRACTION PROCEDURE. Davies, W.; Diggle, W. R. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). June 1968. 7p. Dep. CFSTI. UK 1s. 6d.

The ^{137}Cs is extracted into amyl acetate as cesium tetraphenylborate from an alkaline aqueous solution containing ethylenediamine tetraacetate. No inactive cesium is added. Interference from radioruthenium is decreased by warming the alkaline solution

and then cooling to room temperature prior to the extraction. The amount of ^{137}Cs extracted is measured by gamma spectrometry. (auth)

47079 ACCURATE PROCEDURE FOR THE DETERMINATION OF THE RARE EARTHS BY NEUTRON ACTIVATION. Haskin, L. A.; Wildeman, T. R.; Haskin, M. A. (Univ. of Wisconsin, Madison). J. Radioanal. Chem., 1: 337-48(July 1968).

The principal steps in a well-tested procedure for determination of the rare earths in rocks and minerals are: irradiation of powdered rock samples along with a standard solution mixture of rare earth nitrates; dissolution of the rock powder in the presence of carrier, using Na_2O_2 fusion; separation of the rare earth group from the silicate residue by a sequence of hydroxide and oxalate precipitations; separation of the individual rare earths in samples and irradiated standards by ion exchange; chemical yield determination by EDTA titration; radioassay by beta or gamma counting. The average precision for duplicate analyses by different analysts was found to be better than ±4% mean deviation for a shale with a total rare earth content of 200 ppM. (auth)

47080 NEUTRON ACTIVATION METHOD FOR THE DETERMINATION OF Be, Li, B, F, AND Pb. Lukens, H. R. (Gulf General Atomic Inc., San Diego, Calif.). J. Radioanal. Chem., 1: 349-54(July 1968).

A neutron activation analysis procedure that utilizes reactor pulsing, rapid sample transfer, and a Cherenkov counter for the determination of Be, Li, B, and F via very short-lived radioisotopic indicators is shown to give analytical sensitivities for these elements of 15, 0.0008, 1.1, and 0.83 μg, respectively. Use of a NaI(Tl) counter coupled to the same system enables the detection of 0.4 μg of Pb via 0.8-sec ^{207m}Pb. (auth)

47081 ON THE "MATRIX EFFECT" IN LASER SAMPLED SPECTROCHEMICAL ANALYSIS. Cerrai, E.; Trucco, R. (CISE, Milan). Energ. Nucl. (Milan), 15: 581-7(Sept. 1968).

The laser microprobe was used in the spectroscopic analysis of uranium, zircaloy-2, Aluman, uranium oxide UO_2, and stainless steel. The influence of the internal metallurgic conditions of the samples on emission line intensity was investigated. All the materials considered had well-defined morphologic and structural properties, which were different in every case. It was possible to establish a relationship between spectral line intensity of a macrocomponent and work-hardening or recrystallization conditions, grain size, and mechanical strain present in the same sample. Some interferences are reported on the possible causes of matrix effect and on the applicability limits of laser sampling to quantitative microanalysis for emission spectroscopy. (auth)

47082 DETERMINATION OF MOLYBDENUM AND TUNGSTEN IN PLANTS BY NEUTRON ACTIVATION. RADIOCHEMICAL METHOD ADAPTED TO PLANTS RICH IN CALCIUM. Neuburger, M.; Fourcy, A. (Centre d'Etudes Nucleaires, Grenoble, France). J. Radioanal. Chem., 1: 289-96(July 1968). (In French).

A method for determination of molybdenum and tungsten in plant material using neutron activation analysis was developed. The reactions are: $^{98}Mo(n,\gamma)^{99}Mo$ and $^{186}W(n,\gamma)^{187}W$. Separation was carried out using an anion exchange separation (Dowex 1 × 10; 200 to 400 mesh). Irradiation was carried out in a swimming pool reactor at a thermal flux of about 1 to 2×10^{13} n·cm^{-2}·sec^{-1} for 15 hours. The samples and standard were allowed to cool for 5 to 6 hours before chemical processing. The high concentration of calcium in plants (up to 40 mg/g dry material), the use of hydrofluoric acid for a good absorption, and quantitative recovery of tungsten led to dissolution of the samples with $Hf-H_2O_2$ mixtures containing boric acid to prevent precipitation of fluorides. (auth)

47083 CONTRIBUTION TO THE STUDY OF THE DETERMINATION BY RADIOACTIVATION OF SULFUR AND PHOSPHORUS AT VERY LOW CONCENTRATIONS IN METALS OF VERY HIGH PURITY (ALUMINUM, MAGNESIUM, COPPER, IRON, NICKEL). NEW CAUSE OF ERROR IN THE DETERMINATION OF SULFUR AFTER IRRADIATION BY THERMAL NEUTRONS. PART I. Albert, Ph.; Blouri, J.; Cleyrergue, Ch.; Deschamps, N.; Le Hericy, J. (CNRS, Vitry, France). J. Radioanal. Chem., 1: 297-311(July 1968). (In French).

The determination of sulfur and phosphorus by means of activation analysis in high-purity aluminum and magnesium is described. Irradiations were performed both with thermal and with fast neutrons. A detailed procedure is given and errors not considered so far are discussed. (auth)

47084 THE POLAROGRAPHIC BEHAVIOR OF DYSPROSIUM(III) AND SAMARIUM(III) IN DIMETHYL SULFOXIDE. O'Donnell, Raymond Thomas. East Lansing, Mich., Michigan State Univ., 1967. 125p.

Thesis.

In investigation of the polarographic behavior of Dy(III) and Sm(III) in DMSO of very low water content containing 0.1 M LiCl, one wave, with $E_{\frac{1}{2}}$ at −2.06 V vs. SCE, was obtained for Dy(III), whereas two waves, with $E_{\frac{1}{2}}$ values of −2.00 and −2.18 V vs. SCE, were obtained for Sm(III). The wave related to Dy(III) in DMSO, which is 4 to 5 mM in water, is shown to be irreversible by the curvature and dissymmetry observed in the plot of log $i/(i_d - i)$ vs. $E_{d.e.}$, by the slope of 108 mV in this plot, and by the high temperature coefficient of +6 mV per degree for $E_{\frac{1}{2}}$. Positive chemical tests for Dy in the mercury cathode after prolonged electrolysis at −2.22 V vs. SCE and the decrease in wave height in the polarograms recorded after such electrolysis demonstrated that the ultimate reduction product is Dy. Evidence for a combination of diffusion and adsorption control was obtained from the effect of mercury pressure on wave height, the form of i − t curves, the curvature in the plot of i_d against Dy(III) concentration and the 0.7% temperature coefficient for the wave height. The diffusion coefficient for Dy(III) is 1.56×10^{-6} cm^2 sec^{-1}. The effects of increasing water content in the system on half-wave potential, interfacial tension, viscosity, junction potential, and dielectric constant were studied. Increasing water content must also alter the species and chemical reactions associated with the electrode process. The waves related to Sm(III) in DMSO, which is approximately 5 mM in water, are also shown to be irreversible by curvature and dissymmetry observed in the plot of log $i/(i_d - i)$ vs. $E_{d.e.}$ and by the slopes of 109 and 127 mV in this plot for the first and second wave, respectively. Although the temperature coefficients for $E_{\frac{1}{2}}$, +1.7 and +2.5 mV per degree for the first and second wave, respectively, suggest reversibility, the possibility that the process is irreversible cannot be excluded. Chemical tests for Sm in the mercury cathode after prolonged electrolysis at −2.36, −2.45, and −2.60 V vs. SCE indicate that the metal is not the ultimate reduction product. Spectral and vapor-phase chromatography evidence suggest that dimethyl sulfide is a reduction product. That both waves are principally diffusion controlled was concluded. Effects of increasing water content was also studied for Sm. (Disser. Abstr.)

47085 APPLICATION OF CHERENKOV COUNTING TO COLUMN CHROMATOGRAPHY OF ^{32}P LABELLED SUBSTANCES. Matthews, Harry R. (King's Coll., London). J. Chromatogr., 36: 302-8(Aug. 27, 1968).

Previous studies have indicated that ^{32}P, in aqueous solution containing no scintillator, may be determined by counting the Cherenkov radiation in an unmodified liquid scintillation counter. A method was developed for the analysis of ^{32}P-labeled effluents from column chromatograms using a modified fraction collector. (J.G.B.)

47086 COLORIMETRIC DETERMINATION OF MOLYBDENUM USING SODIUM DIETHYLDITHIOCARBAMIDATE AS REAGENT. Sarma, V. Bhaskara; Suryanarayana, M. (Andhra Univ., Visakhapatnam, India). Z. Anal. Chem., 240: 6-9(1968).

A method for the photometric estimation of molybdenum(V) by extraction of the complex formed with NaDDTC in 5 N HCl solution is discussed. The reduction of Mo(VI) to Mo(V) is achieved with hydrazine sulfate. The color intensity of the chloroform extract of the complex is measured at 450 nm. Beer's law is obeyed up to 500 μg/25 ml of molybdenum. (auth)

47087 PHOTOMETRIC DETERMINATION OF SMALL AMOUNTS OF RHENIUM IN THE ORGANIC LAYER AFTER SEPARATION OF TUNGSTEN AND MOLYBDENUM BY LIQUID–LIQUID EXTRACTION. Thierig, D.; Umland, F. (Univ., Muenster, Ger.). Z. Anal. Chem., 240: 19-23(1968). (In German).

Rhenium(VII) is separated by extraction of tetraphenylarsonium perrhenate from a 100,000-fold excess of W, 10,000-fold excess of Mo, and from Cu and Ni. For photometric determination Re is reduced in the organic layer and the color formed by addition of α-furildioxime is used for the measurement at 530 nm; ε = 29,750 l·Mol^{-1}·cm^{-1}. (auth)

47088 DETERMINATION OF Cu, As, AND Sb IN SULFIDE MINERALS BY NEUTRON ACTIVATION ANALYSIS WITHOUT DESTROYING THE SPECIMENS. Lobanov, E. M.; Akbarov, U.; Nishanov, P. Kh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 3, 20-2(1968). (In Russian).

A simplified magnetic β separator and a scintillation γ spectrometer were used for determining Cu, As, and Sb in minerals without chemically decomposing the specimen. The prepared specimens were irradiated by slow neutrons, 1.8×10^{13} n/cm^2·sec, for 3 hr. Tabulated nuclear characteristics of the basic elements and most common impurities showed that the activity is mainly from the radioisotopes ^{64}Cu, ^{76}As, ^{122}Sb, and ^{69}Zn. Additional colorimetric and radiochemical control analysis was made and the results were compared. (R.V.J.)

47089 ANALYSIS OF LITHIUM BY YIELD OF $^7Li(\alpha,\alpha^1)^{7*}Li$ REACTION. Mikhailov, G. I.; Starchik, L. P. At. Energ. (USSR), 24: 575(June 1968). (In Russian).

An analysis for Li was made using the reactions $^{7}Li(\alpha,\alpha^{1})^{7*}Li$ and $^{7}Li(\alpha,n)^{10}B$ at an energy of 5 MeV. Gamma emission was recorded by a spectrometer with an NaI(Tl) crystal. The results obtained for Li_2O and ^{7}Li showed the relative error for $Li_2O \lesssim 15\%$ at concentrations of $Li_2O < 1\%$, and for ^{7}Li 8% at a ^{7}Li concentration of 1%. The sensitivity threshold for Li_2O is 0.11% and for ^{7}Li 0.06%. The error and sensitivity were determined in analysis lasting 100 sec. Better results could by obtained with slower analysis and higher source activity. (R.V.J.)

47090 POSSIBILITY OF USING AN ELECTROMAGNETIC RADIOISOTOPE SEPARATOR IN CONJUNCTION WITH CHARGED-PARTICLE AND PHOTON-ACTIVATION ANALYSIS. Schweikert, E. A. (Texas A and M Univ., College Station). Talanta, 15: 883-5(Aug. 1968).

A proposal is made for the use of electromagnetic radioisotope separation following charged particle, photon- or neutron-activation. Features of this separation technique are speed and selectivity, opening new possibilities for simultaneous determination of several trace elements, especially the light elements. Preliminary experiments have shown the possibilities if this separation technique is used in conjunction with activation analysis. (auth)

47091 MATHEMATICAL EVALUATION OF MULTICOMPONENT γ-SPECTRA. Paulus, K. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Anal. Chem., 240: 157-62(1968). (In German).

The use of a computer is advantageous for the qualitative and quantitative evaluation of multicomponent γ spectra. The fundamentals of this method are described, the required systems of equations are explained, and the practical application is demonstrated with an example of a mixture of radionuclides. (auth)

47092 NON-DESTRUCTIVE DETERMINATION OF CARBON IN SILICON THROUGH THE REACTION $^{12}C(d,n)^{13}N$. Schuster, E.; Wohlleben, K. (Forschungslaboratorium der Siemens AG, Erlangen, Ger.). Z. Anal. Chem., 240: 175-83(1968). (In German).

The reaction $^{12}C(d,n)^{13}N$ is suitable for the nondestructive determination of carbon in silicon. With thick target irradiation, the induced ^{13}N activity is proportional to the product of the activation depth D* and the cross section σ* averaged over D*. If the activated layer of material is removed after the activity has been measured, the target can be irradiated again. The alternation of irradiation and removal permits determination of the distribution of the carbon in the target. Analyses carried out in this manner on machined silicon discs showed that there is a relatively large decrease in the carbon content from the face towards the center of the disc. In zone-refined silicon rods the carbon was fairly evenly distributed over the entire length of the rod. (auth)

47093 COSMOGENIC ^{10}Be AND ^{26}Al IN MARINE SEDIMENTS. Amin, B. S.; Kharkar, D. P.; Lal, D. (Tata Inst. of Fundamental Research, Bombay). Deep-Sea Res. Oceanogr. Abstr., 13: 805-24 (1966).

Results of measurements of ^{10}Be and ^{26}Al activities in two wide-diameter (12.7 cm) Pacific sediment cores are reported. The cores were raised from regions of the ocean floor where an undisturbed slow accumulation was expected. Several sections up to about one meter depth were analyzed. The β activity of the beryllium extracts was in most cases large enough compared to the background counting rate to permit chemical recycling and measurement of the observed β energy by the absorption method. These tests confirmed that the observed beta activity was due to the radioisotope ^{10}Be. The South Pacific core had a nearly uniform concentration of ^{10}Be up to 100-cm depth, about 4 dis/min ^{10}Be/kg of dry sediment. The activity due to ^{26}Al was measured on a sensitive γ-γ coincidence spectrometer. A clearly discernible signal due to positron decay of ^{26}Al was observed in the core sections analyzed. The average concentration of ^{26}Al was found to be 0.46 dis/min per kg dry sediment. The observed average ratio of ^{10}Be to ^{26}Al activities in the sediment cores clearly points to the conclusion that most of the ^{26}Al activity is of extraterrestrial origin. (auth)

47094 NON-DESTRUCTIVE NEUTRON-ACTIVATION DETERMINATION OF MICRO- AND ULTRAMICROAMOUNTS OF INDIUM IN HIGH-PURITY THALLIUM AND THALLIUM COMPOUNDS. Daiev, Christo; Alexandrov, Stoyan; Daieva, Lilan (Univ., Sofia). Z. Anal. Chem., 239: 369-77(1968). (In German).

Two nondestructive neutron activation methods were described for the determination of indium in thallium metal and thallium compounds. The sensitivity of the first method based on ^{114m}In corresponds to 1×10^{-6} g (standard deviation 4.5 to 8%). The second method (by means of ^{116m}In) permits the determination of ultramicro amounts of indium up to 5×10^{-11} g with a standard deviation of 15%. The influence of many elements (such as Ga, Cu, Al, Cd, Zn, Pb, Ca, Mg, Bi, Fe) was examined. The methods were applied to the determination of indium in thallium metal, oxide, nitrate, sulfate, and chloride. The data obtained agreed with those of the spectrochemical determination. (auth)

47095 PHOTOMETRIC DETERMINATION OF PHOSPHORUS IN FERRONIOBIUM, FERROTITANIUM, AND NIOBIUM ORE. Shimanuki, Takashi (Toshiba Ferroalloy Co., Ltd., Nishiokitama, Japan). Bunseki Kagaku, 17: 928-33(Aug. 1968). (In Japanese).

A rapid method for the determination of phosphorus in ferroniobium, ferrotitanium, and niobium ore, which involves the masking of niobium or titanium with fluoride ion and the extraction of phosphovanadomolybdic acid with methylisobutyl ketone, was presented. Ferroniobium or ferrotitanium (0.1 g) is dissolved in a few ml of nitric and hydrofluoric acids and 1 ml of (1 : 1) sulfuric acid, and is evaporated nearly to dryness. A definite amount of the acid for giving the optimum acid concentration (5 ml of 10N sulfuric acid, 5 ml of 60% perchloric acid or 6 ml of (1 : 1) nitric acid) and an amount of 2% ammonium fluoride solution, 20 ml for ferroniobium or 15 ml for ferrotitanium, are added, and the salts are dissolved by gentle heating. After cooling, 5 ml of 1.2% ammonium vanadate and 10 ml of 10% ammonium molybdate are added, and the solution is diluted to about 50 ml with water. After standing for 10 minutes, 10 ml of methylisobutyl ketone is added, and it is shaken for 10 seconds. The organic layer is dry-filtered, and the absorbance is measured at 420 mμ. Niobium ore (0.5 g) is fused with 3 to 4 g of sodium peroxide, and decomposed with water. After additions of 1 g of ammonium fluoride and 1 drop of hydrogen peroxide (30%), the solution is neutralized with nitric acid and then 20 ml in excess. After cooling, the solution is diluted to 200 ml with water. To a 40 ml aliquot are added 5 ml of 1.2% ammonium vanadate and 5 ml of 10% ammonium molybdate, and then the procedure is carried through as above. The methods are very rapid, and the accuracies are 1.5 to 4.0% for ferroniobium or ferrotitanium and 3.5 to 6.4% for niobium ore. (auth)

47096 APPLICATION OF DIFFERENTIATION CIRCUITS TO POTENTIOMETRIC TITRATION. II. DETERMINATION OF FREE ACID AND URANIUM IN NITRIC ACID SOLUTION CONTAINING URANIUM. Tsuji, Nobuo (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Yokoyama, Yu. Bunseki Kagaku, 17: 939-44(Aug. 1968). (In Japanese).

The titration apparatus, described previously was improved, and used to investigate the alkalimetric titration of nitric acid solution containing uranium. In order to facilitate the detection of an equivalence point of titration, a microammeter was replaced by an autobalancing recorder, on which a differential titration curve as well as the volume of titrant delivered were recorded. In a direct titration of a nitric acid solution containing uranium alone, one of the equivalence points on the differential titration curve corresponded to free nitric acid. In a titration of the same solution after precipitation of uranium by addition of hydrogen peroxide, the equivalence point corresponded to the sum of the free and the uranium-bound nitric acid. Uranium could then be determined from the difference of the two titres. In a titration of a nitric acid solution containing uranium together with aluminum, both the free acid and uranium could be determined after addition of ammonium oxalate. The titration was carried out with a relative error of less than 3% within a couple of minutes. (auth)

47097 SPECTROCHEMICAL ANALYSIS OF ZIRCONIUM AND ITS ALLOY. V. X-RAY FLUORESCENCE ANALYSIS OF ZIRCONIUM ALLOYS. Matsumura, Tetsuo; Kotani, Naomi; Goto, Takeshi (Kobe Steel Ltd., Japan). Bunseki Kagaku, 17: 933-9(Aug. 1968). (In Japanese).

X-ray fluorescence method for the determination of alloying elements in zirconium alloys is described. The experiment was conducted to develop a method generally applicable to zirconium alloys in a wide variety of analytical elements and sample shapes. The analyses were made on both the solid disk samples and the glass beads, the latter being prepared by melting 1 g of oxide of alloy with 15 g of sodium tetraborate. The glass beads method would be applied when a solid disk sample and/or its standards were not available. Tin, nickel, iron, and chromium in zircaloy and niobium in zirconium–niobium alloy were determined by the metallic disk method, and niobium and copper in binary alloys by the glass beads method. The accuracy and precision of the methods were superior to those by the emission spectrography. (auth)

47098 REVIEW OF ANALYTICAL METHODS FOR DETERMINATION OF STABLE AND RADIOACTIVE CESIUM. Bauman, Alica (Inst. for Medical Research, Zagreb). Arh. Hig. Rada Toksikol., 18: 456-77(1966). (In Serbo-Croatian).

Numerous radiochemical methods for determination of radiocesium and some analytical methods for determination of stable Cs are described. Particular attention is paid to the methods for determination of fallout ^{137}Cs in samples from the biosphere. The literature listed 150 references related to papers published in this field in the past 5 years and to the review articles and original scientific papers published earlier but considered basic for most of the methods currently used. The methods are discussed in terms of gravimetric, volumetric, spectrochemical, ion-exchange, adsorption, and extraction techniques. Paper electrophoretic procedures as well as γ spectrometric methods that can be used for ^{137}Cs are also presented. Activation analysis techniques for determining stable Cs are additionally reviewed. (BBB)

47099 CONDUCTOMETRIC DETERMINATION OF LANTHANUM, PRASEODYMIUM, AND SAMARIUM AS ORTHOVANADATE. Prasad, Sarju; Srivastava, R. C. J. Proc. Inst. Chem. (India), 38: 263-5(1966).

A series of conductometric titrations of La, Pr, and Sm with sodium orthovanadate were carried out successfully at 25 ± 0.5° in a 10 to 20% aqueous ethanol medium. An overall effect of ethanol on the results was also studied. Curves obtained in the titrations showed a sharp break at the end-point and indicated the formation of rare earth vanadate. The procedure affords a convenient means for accurate titrimetric determination of rare earth ions on microscale. (11 references) (Indian Science Abstr.)

47100 SOME PRACTICAL APPLICATIONS OF GAMMA-RAY SPECTRAL RESOLUTION TO RADIONUCLIDE DETERMINATION. Pruitt, M. E.; Prestwood, Sue H.; Parker, H. A. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 5: 253-9(1968).

Resolution of complex gamma spectra obtained with NaI(Tl) detectors is a means to fast accurate determinations of radionuclides. Detection limits, a function of counting statistics, can be extended by use of preferential counting techniques and simple chemical separations. The method is applicable to the determination of radionuclides singly and in complex mixtures. Two experiments are described to demonstrate the flexibility of spectral resolution. A table is included to show the correlation of data obtained by spectral resolution and by conventional radiochemical analysis. Spectral resolution simplifies the analysis of complex mixtures and reduces the cost of analysis with no sacrifice of the quality of the data. (auth)

47101 PROTON REACTION DETERMINATION OF LITHIUM AND FLUORINE IN MOLTEN SALT REACTOR GRAPHITE. Macklin, R. L.; Gibbons, J. H.; Ricci, E.; Handley, T.; Cuneo, D. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 5: 269-74 (1968).

Prompt radiations from the reactions $^{7}Li(p,n)$ and $^{19}F(p,\alpha\gamma)$ were applied to measure concentrations of the target nuclei in graphite using protons from the ORNL-3-MV Van de Graaff accelerator. A sample irradiated nine months in the Molten Salt Reactor Experiment shows over a hundred times the lithium and fluorine penetration found in an unirradiated control sample. (auth)

47102 USE OF SODIUM CERIUM EDTA FOR TITRIMETRIC DETERMINATION OF METALLIC ELEMENTS WITH ETHYLENEDIAMINETETRAACETIC ACID. Yamamura, Stanley S. (Idaho Nuclear Corp., Idaho Falls). Anal. Chem., 40: 1898-1901(Oct. 1968).

A study was made to establish a procedure that could be used to determine reliably a large number of metals without special procedural adaptations for different metals. The titrimetric procedure based on the use of sodium cerium(III) EDTA octahydrate salt satisfied these requirements. The method was found to be applicable to 33 metals including Am, Bi, Cd, Co, Cu, Fe, Ga, Hg, In, the lanthanides, Mn, Ni, Pb, Sc, Tl, V, Y, Zn, and Zr. It is probably applicable to Bk, Cf, Cm, and Hf as well. The proposed method is basically a replacement titration procedure. An unmeasured excess of stoichiometric sodium cerium(III) EDTA salt is added to the acidic solution of the metal to be determined, then the solution is adjusted to pH 5.6 ± 0.25 with pyridine and titrated with a standard EDTA solution to a visual indicator end point. The release of cerium(III) is dependent on the relative stabilities of the Ce(III) EDTA complex and the EDTA complex of the metal being determined. The proposed procedure is recommended for the standardization of pure metal solutions. (D.H.M.)

47103 MODIFIED SCINTILLATION COUNTING TECHNIQUE FOR DETERMINATION OF LOW LEVEL ^{85}Kr. Sax, N. I.; Denny, J. D.; Reeves, R. R. (New York State Dept. of Health, Albany). Anal. Chem., 40: 1915-16(Oct. 1968).

A modified scintillation counting technique was developed that is sensitive, convenient, and economical for routine atmospheric ^{85}Kr measurements. It uses inexpensive plastic-scintillator shavings contained within a gas-tight vial that can be filled with Kr-containing gas and counted efficiently by scintillation spectrometry. If the exact percentage of impurities is determined, precise ^{85}Kr determinations can be made, limited only by total counts obtainable. The overall method permitted a detection level for ^{85}Kr as low as 1pCi/m^3 of air sample. (D.H.M.)

47104 LASER-MICROSCOPE SYSTEM AS A MICROSAMPLING DEVICE. Adams, M. D.; Tong, S. C. (Argonne National Lab., Ill.). Anal. Chem., 40: 1762-5(Oct. 1968).

A method of obtaining microsamples of refractory materials was developed. A laser–microscope system is used to volatilize a chosen area which may range from 5 to 200 μ in diameter and 5 to 100 μ deep. Vaporized material is then condensed on a transparent cover plate held 0.2 to 0.5 mm above the specimen surface. Samples on the order of 10^{-6} gram taken from a specimen of irradiated UO_2 were examined by four methods of analysis: alpha spectrometry, gamma spectrometry, neutron activation, and mass spectrometry. (auth)

47105 DETERMINATION OF TRITIUM DISTRIBUTION IN URACIL AND URIDINE. I. Kusama, Keiichi (Shizuoka Univ., Japan). J. Biochem. (Tokyo), 63: 561-5(Mar. 1968).

Methods are described for determination of the distribution of ^{3}H in the pyrimidine ring of commercial preparations of tritiated uracil and uridine. Tritiated uridine was degraded by the periodate and phenylhydrazine method to uracil without release of ^{3}H from the pyrimidine ring at the C5 position. However, by treatment with 12N perchloric acid the C5-^{3}H was completely eliminated. The release of C5-^{3}H from uracil and uridine by boiling with 1N acid was first order and the velocity constants were calculated. The C6-^{3}H was very stable to this acid treatment. The distribution of ^{3}H in commercial 5,6-^{3}H-uracil and 5,6-^{3}H-uridine, which were tritiated by catalytic exchange in $^{3}H_2O$, was measured by bromination and by acid treatment. The percentage of ^{3}H at C6 was 0.7 to 0.8% and 2 to 4% of the total ^{3}H bound in the pyrimidine ring of uracil and uridine, respectively. (BBB)

47106 ON THE DETERMINATION OF ^{137}Cs IN OIL-BEARING SEEDS AND FRUITS. Seher, A.; Buerjes, G. (Bundesanstalt fuer Fettforschung, Muenster, Ger.). Fette-Seifen-Anstrichm., 70: 53-8(1968). (In German).

A wet extraction procedure, which is faster and less susceptible to interference than the earlier method based on careful ashing, was developed for the determination of ^{137}Cs in seeds and fruits containing oil. An ion exchanger based on K cobaltiferrocyanide was employed for concentration of dissolved Cs and for separation for impulse measurements. Analyses made by this procedure show much smaller errors than the earlier methods. Detailed instructions for wet extraction with 4N HCl, for removal of PO_4^{-3} with Ca(II), for Cs precipitation by molybdophosphate, for precipitation by hexachloroplatinate, for concentration by ion exchange (details of an apparatus for this purpose are described and illustrated), and for calibration of the exchanger samples with ^{137}Cs are all described. Using the three different methods for syntheses of the ion exchangers mentioned above, the calibration factors agreed within 25%. Results for linseed oil, palm seeds, and soyabeans gave data within 3.5% of accepted values, as tested by an addition procedure. (BBB)

47107 MODIFIED MICRO COMBUSTION METHOD FOR TRITIUM IN ORGANIC MATERIAL. Maurer, H. Rainer (Max-Planck-Inst. fuer Virusforschung, Tuebingen, Ger.). Z. Physiol. Chem., 349: 115-17(Jan. 1968). (In German).

The Gupta micro combustion method (Anal. Chem., 38: 1356 (1966)) for estimating ^{3}H, ^{14}C, and ^{35}S in amounts up to 3 mg (dry weight) was modified and new apparatus introduced to allow ^{3}H to be determined with greater accuracy. The methodological improvements concern the use of a Pt combustion stand, lens paper, and liquid scintillator. The loss of counting efficiency by H_2O and O_2 quenching amounts to only 6% on the average. Several conditions are described that must be observed to maintain the reproducibility of the method (±1.6 to 2.2% S. D.). The tritium counting efficiency attainable is 25%. Four liquid scintillators were examined with respect to their water-dissolving capacities and counting efficiencies. (BBB)

47108 RAPID DETERMINATION OF BERYLLIUM BY A DIRECT READING ATOMIC ABSORPTION SPECTROPHOTOMETER. Bokowski, D. L. (Dow Chemical Co., Golden, Colo.). At. Absorption Newslett., 6: 97-100(Sept.-Oct. 1967).

A sensitive and specific analytical method for beryllium in air, wipe, biological, and packing material samples was developed. A single-beam atomic absorption spectrophotometer with a high-temperature nitrous oxide–acetylene flame was used. The chemical technique for sensitivity enhancement and decontamination

from radionuclides is described. Maximum time expenditure for an analysis is less than 30 minutes. Multiple samples may be run in the same time period. Sensitivity of the method is less than 0.04 μg/ml of beryllium with a repeatability of approximately 2% of the amount present. Decontamination factors for uranium and transuranium elements were greater than 5000. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 47158, 47204, 47209, 47214, 47223–47225, 47695, and 48147.

47109 (AERE-R-5323) THE MECHANISM OF ADSORPTION OF RARE EARTH CATIONS ON TO SURFACES FROM VERY DILUTE SOLUTION ("RADIOCOLLOIDAL" ADSORPTION). Mellish, C. E.; Hill, M. R. H.; Glanville, D. E. (United Kingdom Atomic Energy Authority, Wantage (England). Research Group). Dec. 1966. 13p. Dep.

Previous qualitative work on cation adsorption was followed by quantitative measurements on the adsorption of rare earth ions on electrochemically oxidized platinum, stearic acid monolayers, and tungsten metal. On all of these the same type of process appears to take place; adsorption is dependent on pH and on oxide coverage (on Pt) but independent of cation concentration even at carrier-free levels. The results indicate that ions are held to the surface by hydrogen bonds or covalent bonds in addition to simple ionic attraction. The interaction may be used as an investigational tool for the study of surface oxides, as with the experiments on platinum, for the measurement of diffusion coefficients, as with the experiments with stearic acid monolayers, and for substoichiometric dilution analysis, using tungsten surfaces. (auth)

47110 (BAW-3714-7) GEL-ADDITION PROCESS CHEMICAL STUDIES. Quarterly Progress Report No. 7, February–April 1968. Dewell, E. H. (comp.) (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). July 1968. Contract AT(30-1)-3714. 57p. Dep. CFSTI.

Development of the sol-gel process and related processes was continued. Emphasis was shifted to the Oak Ridge mixed sol approach, and development of the gel-addition technique continued at a reduced level. Oxide characterization work continued, and an irradiation program combining thermal and fast exposures was agreed upon. Gel-addition experiments designed to increase the pickup of plutonium by UO_2 gels from aqueous solutions were begun; among the procedures tested, homogeneous hydrolytic precipitation of Pu(III) by urea during the pickup step showed the most promise. Pickup in one contact increased to about half the required value for fast reactor fuels. Assay of both plutonium and uranium is now routinely carried out by weight aliquoting and controlled-potential coulometry. Shipper-receiver differences of about 2% in plutonium are still encountered. A method of measuring free acid levels in uranium and plutonium nitrates using ammonium oxalate as a complexing agent was tested and is now in routine use. Methods used to prepare specimens for ceramographic examination were modified to eliminate polishing artifacts that interfere with microscopic examination. During examination of spherical UO_2 gels and oxides, small quantities of a second phase were observed and identified as silica from spectrographic and petrographic observations. Metallic inclusions observed in coprecipitated powders were removed by magnetic separation. The metallic particles are attributed to corrosive attack on a nickel alloy furnace liner. Irradiation specimens containing shards and pellets made from coprecipitated $(U,Pu)O_2$ powders and spherical particles made from mixed sol-gel $(U,Pu)O_2$ were fabricated. The fuels for the irradiation specimens were characterized, and the specimens were fully inspected in preparation for irradiation during the next quarter. Twenty-eight fuel capsule exposures are planned for the BAWTR to measure both the time required for restructuring of particulate fuels and their offgassing characteristics. Two 19-pin subassemblies will be exposed in EBR-II. Some pins will be removed after an exposure of 25,000 MWD/T and replaced with fresh material. A total of 76 fuel pins is planned for EBR-II. The first laboratory run of mixed sol material is complete. UO_2 sol preparation was routine. Several PuO_2 sol preparations formed precipitates that did not resuspend after thermal denitration. Some conversion to Pu(VI) was noted. (auth)

47111 (LA-3945) THERMODYNAMIC PROPERTIES OF PuN BY GALVANOSTATIC POTENTIAL DETERMINATION. Campbell, George M. (Los Alamos Scientific Lab., N. Mex.). Feb. 1, 1968. Contract W-7405-eng-36. 9p. Dep. CFSTI.

The emf of the cell $Pu(s,l)|PuCl_3$, $LiCl-KCl|N_2(g)$, PuN(s) was determined over the temperature range 714 to 1032°K. By using a W microelectrode, the equilibrium potential of the Pu(s,l) electrode was determined by a galvanostatic technique, avoiding the complications rising from reaction of N_2 with Pu. Over this temperature range, at 1 atm N_2 the emf is $E = 7.90071 - 2.31690 \times 10^{-2} + 2.517855 \times 10^{-5}\ T^2 - 9.1644 \times 10^{-9}\ T^3$ (±0.003) volts. Above the melting point of Pu(913°K) the standard free energy of formation of PuN is $-\Delta G_T^\circ = 73.8 - 0.0225\ T$ kcal/mole PuN. From the condition $S^\circ_{298}(PuN) - S^\circ_{298}(Pu) = S^\circ_{298}(UN) - S^\circ_{298}(U)$ the estimate $-\Delta H^\circ_{298} = 72.5$ kcal/mole is made. (auth)

47112 (ORNL-4254, pp 88-173) CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Topics covered include: fuel salt composition and purity, MSRE fuel circuit corrosion chemistry, isotopic composition of uranium in MSRE fuel salt, fission product behavior in the MSRE, fission product distribution in an MSRE graphite surveillance specimen, proton reaction analysis for lithium and fluoride in MSR graphite, surface phenomena in molten salts, properties of molybdenum fluorides, mass spectrometry of molybdenum fluorides, spectroscopic studies of fission product fluorides, preparation of NbF_5, thermodynamics of $LiF-BeF_2$ melts, electrolysis of $LiF-BeF_2$ melts with a bismuth cathode, electric conductivities in molten fluoride systems, specific conductance in $LiF-BeF_2$, stirred reaction vessel for molten fluorides, chemistry of silica in molten $LiF-BeF_2$, silica cell and furnace for electrochemical measurements with fused fluorides, MSBR fuel reprocessing by reductive extraction into molten bismuth, removal of structural metal fluorides from a simulated MSRE fuel solvent, protactinium studies in the high-alpha molten-salt laboratory, phase relations in fluoroborate systems, nonideality of mixing in KBF_4-NaF (or KF) systems, heat content of $NaBF_4-NaF$, solubility of Th in $LiF-ThF_4$ mixtures, dissociation of BF_3, chemical thermodynamics of the system $NaBF_4-NaF$, corrosion of Hastelloy N and its constituents in fluoroborate melts, and compatibility and immiscibility of molten fluorides. (M.C.G.)

47113 (ORNL-4305) MONAT: A FORTRAN 63 PROGRAM FOR COMPUTING THERMODYNAMIC PROPERTIES OF MONATOMIC IDEAL GASES. Fontana, M. H. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 19p. Dep. CFSTI.

A computer program was written in Fortran 63 for generating tables of thermodynamic properties of monatomic ideal gases, given the spectroscopic constants. The properties computed and presented are the specific heat at constant pressure, entropy, enthalpy referred to 0°K, and free energy functions. This is done for temperatures from 100 to 6000°K in 100°K increments. A sample calculation is presented for monatomic chromium ideal gas, extended to 6000°K. This is compared with separately published data to 3000°K. (auth)

47114 PHOTOLYSIS OF CARBON SUBOXIDE IN THE PRESENCE OF HYDROGEN. Forchioni, Alain (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Willis, Clive. J. Phys. Chem., 72: 3105-10(Sept. 1968).

Carbon suboxide was photolyzed in the presence of hydrogen at 2537, 1470, and 1236 Å. At all wavelengths virtually identical results are obtained and the gaseous products formed are carbon monoxide, methane, and ethane with traces of propane. A mechanism involving methylene is proposed to explain the results. The relative rate constant for the reaction of ^1C_2O with carbon suboxide compared with hydrogen was found to be 160 ± 30. The possibilities for the primary species and subsequent reactions are discussed. (auth)

47115 FACTORS INFLUENCING HYDROGEN–DEUTERIUM EXCHANGE OF AMIDES. Feidelseit, Philip Leon. Evanston, Ill., Northwestern Univ., 1967. 101p.

Thesis.

The observed rate of H–D exchange of a protein was frequently interpreted in terms of its conformation in solution. Slower exchange rates are related to the existence of intramolecular hydrogen bonds, and this hydrogen bonding imposes a specific conformation on the protein. The specific acid and base catalysis of the exchange reaction was demonstrated along with the effect of varying the amount of H bonding in a model system (N-methylacetamide–D_2O–dioxane). Results of these experiments indicate that the extent of H bonding is not the dominant factor in the H–D exchange. Additional model systems were examined in an attempt to elucidate other factors that contribute to the rate of H–D exchange one experimentally observes. The rates of exchange of various amides and related compounds with D_2O were studied by monitoring the appearance of the 1.4 mμ overtone band of the O—H stretching vibration of HOD in D_2O on a Cary Model 14R

recording spectrophotometer. The half lives of exchange were found to vary over a wide range in model compounds. For example, the inaccessibility of the amide groups as in ω-lauric acid lactam, appears to be an important reason for its observed slow exchange. The configuration of the amide group, cis in 2-pyrrolidone and trans in N-ethylacetamide, also has an effect on the exchange rates. The introduction of salts such as LiBr, which are capable of restricting the effective water concentration through hydration, or tetraalkylammonium halides, which may do the same by forming clathrates, in all cases slow the rate of exchange. An increase in the exchange rate due to the addition of salts of relatively strong acids ($NaIO_4$, Na_2SO_4, Na_2DPO_4) was attributed to the formation of a six membered intermediate between the amide and a protonated form of the acid which may facilitate exchange. Rates of exchange of the series N-methyl-, N-ethyl-, N-propyl-, N-butylacetamide indicate steric effects in the molecule, or possibly the arrangement of the surrounding solvent due to the presence of nonpolar groups in the molecule, tend to slow down the rate of exchange as the molecular weight of the N-substituted group increases. (Disser. Abstr.)

47116 GAS CHROMATOGRAPHIC CHARACTERISTICS IN THE SEPARATION OF PROTIUM AND DEUTERIUM FORMS OF TRIMETHYLSILYL SUGARS. Saha, N. C.; Sweeley, Charles C. (Univ. of Pittsburgh). Anal. Chem., 40: 1628-33(Sept. 1968).

Separation of the protium and deuterium forms of trimethylsilyl derivatives of carbohydrates by gas–liquid chromatography was investigated in the context of present theories of peak separation and of band broadening factors. Disengagement of peak centers has been related to differences in vapor pressure and differential solubility in the liquid phase for isotopic-substituted and parent species. The gas chromatographic method for determining gaseous interdiffusion coefficients was extended for use with mixed solutes in a dilute solution. Changes in anomeric configuration had a more striking effect on gaseous diffusion coefficient than the effect caused by isotopic substitution in sugars. About 80% of the theoretical plate height was contributed by the gas phase. Isotopic substitution was also reflected by some differences in the solute–solvent interaction forces, especially the binary liquid diffusion coefficients. (auth)

47117 TRANSIENT CONVECTIVE DIFFUSION IN CAPILLARIES. Overman, Allen R. (Univ. of Illinois, Urbana). J. Phys. Chem., 72: 3286-8(Sept. 1968).

A transient solution was obtained of the one-dimensional continuity equation for convective diffusion in a capillary. The resulting equation was compared with data in the literature for the system D_2O–H_2O, and an agreement of 2% was found in the transient domain for a Peclet number of 3.88. A simple physical concept of solute transport in this system accrues from the analysis. (auth)

47118 NEW TERNARY THORIUM AND URANIUM COMPOUNDS MYX. Hulliger, F. (Cyanamid European Research Inst., Geneva). J. Less-Common Metals, 16: 113-17(Oct. 1968).

New metallic compounds, ThYX, and UYX (X = S, Se, Te; Y = P, As, Sb, Bi) were synthesized and found to crystallize in the PbFCl structure. The uranium compounds were found to be ferromagnetic at low temperatures. The occurrence of metallic and nonmetallic properties in the PbFCl phases is discussed. (auth)

47119 COMPLEXES OF URANYL ION WITH VARIOUS CARBOXYLIC ACIDS. Ramamoorthy, S.; Santappa, M. (Univ. of Madras). Curr. Sci. (India), 37: 403-4(July 20, 1968).

Systems of uranyl ions with various organic acids were studied using a pH titration method to determine composition and formation constants of the complexes in the pH range 1.5 to 3.5. In general, the basicities of the monodentate ligands had little influence on the stabilities of the corresponding UO_2^{2+} complexes. Steric factors and ring size presumably determine the metal chelate stabilities with bidentate ligands. (J.G.B.)

47120 SYNTHESIS OF POTENTIALLY RADIOPROTECTIVE α-MERCAPTOACETAMIDINES AND DERIVATIVES. Conway, Terry Thomas. Chicago, Univ. of Illinois, 1967. 167p.

Thesis.

The synthesis of a series of N-substituted-α-mercaptoacetamidinium chlorides, $HSCH_2C(=NH_2^+)NHR\ Cl^-$ (I), is described. These were obtained in a two step reaction sequence by first treating α-chloroacetamidinium chlorides, $ClCH_2C(=NH_2^+)NHR\ Cl^-$ (II), with an aqueous solution of trisodium phosphorothioate at 25° to form amidinium sodium phosphorothioates, $^-O_3PSCH_2C(=NH_2^+)NHR\ Na^+$ (III). These phosphorothioates were immediately hydrolyzed in situ with 6 N hydrochloric acid under nitrogen to form I in 40–80% yield. In this manner III was converted to I where R equals hydrogen, cyclopentyl, cyclohexyl, benzyl and 6-methyl-2-picolyl. The radioprotective activities of these compounds are not yet available. It was possible to isolate and characterize one of the amidinium sodium phosphorothioates (III: R = H), which showed the proton magnetic resonance signal for the methylene protons as a doublet due to long-range coupling to the phosphorus atom (J_{P-CH_2} = 13.5 cps) at δ 3.68 in D_2O. Based on the previously reported activity of α-amidinium Bunte salts, $^-O_3SSCH_2C(=NH_2^+)NHR$ (IV), additional members of this series were prepared by treatment of II with an aqueous solution of sodium thiosulfate (20–80% yield). The following α-amidinium Bunte salts were prepared: R in IV is ω-cyclohexylalkyl [cyclo-$C_6H_{11}(CH_2)n$ where n = 0-4], cyclopentyl, cycloheptyl, cyclooctyl, p-methoxyphenylalkyl, γ-methoxypropyl and tetrahydrofurfuryl. Several of the ω-cyclohexylalkyls, the cyclopentyl and the cyclooctyl α-amidinium Bunte salts were found to possess good radioprotective activity. All of the Bunte salts bearing oxygen-containing substituents were inactive. Hydrolysis of a number of α-amidinium Bunte salts, IV, to the corresponding α-mercaptoacetamidinium chlorides, I, was attempted. Complete hydrolysis of IV took about 17 hours at 96° with 6 N hydrochloric acid (followed by pmr spectroscopy) and the products isolated (even when the hydrolysis was carried out under nitrogen) were the α-amidinium disulfides, $[SCH_2C(=NH_2^+)NHR]_2\ 2Cl^-$ (V), where R was hydrogen, cycloheptyl, cyclooctyl and benzyl. Catalytic reduction of the unsubstituted member of this series (V: R = H) with hydrogen over 10% palladium on charcoal yielded I (R = H). Oxidation of the N-benzyl compound (V: R = $C_6H_5CH_2$) with 30% hydrogen peroxide solution formed the corresponding sulfonic acid, $^-O_3SCH_2C(=NH_2^+)NHCH_2C_6H_5$, whose structure was identical to the product from the reaction of N-benzyl-α-chloroacetamidinium chloride (II: R = $C_6H_5CH_2$) with sodium sulfite. (TSS) (Disser. Abstr.)

47121 ^{13}C KINETIC ISOTOPE EFFECT IN THE THERMAL ISOMERIZATION OF METHYL ISOCYANIDE. Wettaw, John Frederick. East Lansing, Mich., Michigan State Univ., 1967. 117p.

Thesis.

The ^{13}C kinetic isotope effect in thermal unimolecular isomerization of methyl isocyanide to acetonitrile was investigated from 1 atm to 1 cm pressure at 243.4, 226.0, and 213°C. Purified methyl isocyanide (labeled with natural abundance ^{13}C in both carbon positions) prepared from AgCN and methyl iodides was isomerized and the remaining unreacted methyl isocyanide separated by gas chromatography from the product acetonitrile. The products were oxidized over copper oxide at 600°C and the CO_2 separated from the water and nitrogen products and purified by vacuum sublimation. The $^{13}CO_2/^{12}CO_2$ molar ratio R was determined on the CO_2 derived from oxidation of methyl isocyanide (R_{NC}) and acetonitrile (R_N) obtained at fraction f of reaction. The three data R_{NC}, R_{CN}, and f define a ^{13}C kinetic isotope effect r = k/k', which is an average of the isotope effects $r_1 = k/k_1$ arising from labeling in the methyl carbon position and $r_2 = k/k_2$ arising from labeling at the isonitrile C. At high pressures the average isotope effect r is given by $r_\infty = 0.998 \exp(20 \pm 5/RT)$. At lower pressures, the effect declines as expected for a unimolecular reaction, the values at 1 atm and at 1 cm being 1.018_5 and 1.011_5, respectively, at 226°C. The ^{13}C isotope effect suggests that the major changes in frequency pattern in going from the molecule to the complex involves lowering the C–N and N ≡ C stretching frequencies. The results indicate substantially larger ^{13}C isotope effect associated with labeling at isonitrile position than with that arising from labeling at the methyl carbon. (Disser. Abstr.)

47122 SORPTION OF ORTHOPHOSPHATE ON CRYSTALLINE METAL OXIDES. Vissers, D. R. (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 72: 3236-44(Sept. 1968).

Isotherms for the sorption of orthophosphate from aqueous solutions onto crystalline metal oxide surfaces such as thoria or zirconia contain plateau regions that remain unchanged over wide ranges of concentration of the sorbing species and that change abruptly from one plateau to another when they do change. The amount of orthophosphate sorbed per unit area of surface appears to be independent of the sintering temperature of the oxide. The plateau regions present in the experimentally determined sorption isotherms appear to be related to monolayer coverages predictable from geometric considerations of the orthophosphate molecule and the metal oxide surfaces presumed to be present. This interpretation of the results indicates that the sorption of orthophosphate from an aqueous medium onto a crystalline metal oxide surface a fixed stoichiometry exists between the sorbed phosphate molecules and the metal oxide sites present on the surface for a fairly wide range of conditions. (auth)

47123 IR SPECTRA OF N-ACETYLGLYCINE AND N-ACETYLGLYCINE-D_2 IN THE 700 TO 250 cm^{-1} REGION. Callahan, Sr. M. Vincent; May, Leopold (Catholic Univ. of America, Washington, D. C.). J. Mol. Struct., 2: 154-7(Aug. 1968).

Since x-ray studies of N-acetylglycine indicate that it has the same crystal orientation as glycylglycine (Gly-Gly), the simplest dipeptide containing the CONH group, its spectrum was compared with that of the dipeptide. Ir studies were extended into the cesium bromide region. Assignments were made for ir absorption bands for normal and deuterated acetylglycine. (auth)

47124 ADSORPTION OF URANIUM BY ION EXCHANGE RESINS IN THE PRESENCE OF PERMANGANATE. Tataru, S.; David, B.; Filip, Gh. (Section de Recherches Technologiques pour les Metaux Rares, Bucharest). Rev. Roum. Chim., 13: 787-91(June 1968). (In Rumanian).

The influence of MnO_4^- ions on the adsorption of uranium from carbonate solutions by strongly basic ion exchange resins was studied. It was found that the presence of MnO_4^- ions in the uranium solutions undergoing adsorption by ion exchange resins reduced the adsorption capacity of the strongly basic ion exchange resins. The phenomenon can be explained by the concomitant adsorption of the uranium and the permanganate by the exchange resin of the anions and by the partial elution of the uranium adsorbed by the permanganate anions. (tr-auth)

47125 URANIUM CHALCOGENIDES. I. STRUCTURAL AND MAGNETIC PROPERTIES OF SULPHIDES AND SELENIDES IN THE RANGE $UX_{1.5}$ TO UX_3. Groenvold, F.; Haraldsen, H.; Thurmann-Moe, T.; Tufte, T. (Univ. of Oslo). Contract AT(11-1)-1149. J. Inorg. Nucl. Chem., 30: 2117-25(Sept. 1968). (COO-1149-116).

X-ray studies of uranium sulphides confirmed the existence of the U_3S_5 and US_3 phases and showed that $US_2\alpha$ and $US_2\beta$ are phases with different compositions. $US_2\alpha$ with tetragonal structure has a range of homogeneity between about $US_{1.80}$ and $US_{1.93}$ after heat treatment up to 1300°C. Samples with composition $US_{1.95}$ and $US_{1.98}$ contain a mixture of $US_2\alpha$ and $US_2\beta$, while $US_{2.00}$ consists of only $US_2\beta$ with orthorhombic structure and has no appreciable range of homogeneity. The uranium-richest selenide prepared by heating the elements at 1000°C was the U_3Se_5-phase. At higher selenium contents, the phase $USe_2\alpha$ was observed but not the $USe_2\beta$- or $USe_2\gamma$-phases. $USe_2\alpha$ has a range of homogeneity between $USe_{1.85}$ and $USe_{2.0}$ and is isostructural with $US_2\alpha$. Magnetic susceptibility measurements in the range from −185 to 445°C on samples with compositions $US_{1.6}$, $US_{1.9}$, $US_{2.0}$, $US_{3.0}$, $USe_{2.0}$, and $USe_{3.0}$ indicated the presence of two unpaired 5f electrons in all the samples. (auth) (UK)

47126 REACTIONS OF URANIUM CARBIDES WITH AQUEOUS SODIUM HYDROXIDE SOLUTIONS. Sears, Mildred Bradley; Pattengill, Merle D.; Ferris, Leslie M. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem., 30: 2111-16(Sept. 1968). (ORNL-P-3660).

Reactions of the uranium carbides with 2 to 18 M NaOH solutions resulted in oxidation of part of the uranium to the hexavalent state, with the accompanying evolution of hydrogen. The hydrocarbons produced in reactions with uranium monocarbide and sesquicarbide were the same as those produced using water. With the dicarbide, some of the hydrogen resulting from oxidation of the uranium reacted with the carbide carbon, forming more gaseous hydrocarbons (and presumably less wax) than were obtained with water; the relative concentrations of the various C_2- to C_5-hydrocarbons were independent of the NaOH concentration. (auth) (UK)

47127 INFRARED ABSORPTION INTENSITY OF THE ν_3 VIBRATION OF THE UO_2^{2+} ION IN NITRATE AND THIOCYANATE MEDIA. Larsson, Ragnar (Univ. of Lund, Sweden). Acta Chem. Scand., 22: 983-94(1968).

The intensity of the asymmetric stretching vibration, ν_3, of the UO_2^{2+} ion was measured in a salt medium of $NaNO_3$, keeping the ionic strength = 4 M. In order to try to correct for solvent effects, the ir absorption of aqueous SO_2 solutions was also determined and compared with gas phase data. For a series of solutions containing various concentrations of NaSCN it was observed that the intensity increases by about 10% when thiocyanate ions are coordinated to the uranyl group. The change of the ν_3 frequency was used for a determination of the complex formation curve. This was found to agree well with other data. Hence the frequency change is not a medium effect and it was assumed that the same holds then for the intensity change. This change was ascribed to a decrease of the bond order of the U−O bond caused by the coordination of thiocyanate ions. From the absorption values the dipole moment derivative, $\partial\mu/\partial r$, was calculated ($\pm 9.2 \times 10^{-10}$ esu) and the charge distribution of the UO_2^{2+} ion was estimated as $-1 + 4 - 1$. (auth) (Denmark)

47128 ISOTOPE EXCHANGE RATES. V. THE HOMOGENEOUS REACTION BETWEEN H_2S AND D_2. Burcat, Alexander (Hebrew Univ., Jerusalem); Lifshitz, Assa; Lewis, David; Bauer, S. H. Contract AT(30-1)-3211. J. Chem. Phys., 49: 1449-57 (Aug. 15, 1968). (NYO-3211-5).

Single-pulse shock-tube data were obtained for the homogeneous isotopic exchange reaction between deuterium and hydrogen sulfide, highly diluted in argon, over the temperature range 1260 to 1590°K. Three sets of experiments were performed independently in two laboratories. H_2S/D_2 ratios were varied over the range 4/1−1/4, at total reaction densities from 6×10^{-5} to 5×10^{-5} moles/cm^3. The agreement among the three sets of data is generally good. An average activation energy of 52 ± 3 kcal/mole was deduced from them. All three sets of data may be fitted by a second-order power rate expression which is first order in D_2 and roughly ½ order with respect to H_2S and to Ar. These data support a mechanism, suggested previously for similar isotopic exchange reactions, in which metathesis reactions during collisions between H_2S and D_2 occur with significant probability only when the deuterium molecule contains at least a critical amount of vibrational energy. The rate-limiting process is the maintenance of an adequate population in the 4th and 5th vibrational levels of deuterium. The relative efficiencies for excitation of deuterium by collisions with the various species present, as determined from the kinetics data, are in reasonable agreement with values determined directly from vibrational relaxation studies. (auth)

47129 STABILITY CONSTANTS OF SOME URANYL COMPLEXES. Ramamoorthy, S.; Santappa, M. (Univ. of Madras). Bull. Chem. Soc. Jap., 41: 1330-3(June 1968).

Complexes of uranyl ion with benzoic, phenylacetic, phenoxyacetic, thiomalic, and itaconic acids were studied by pH titration method at 31 ± 0.1°C. A 1:1 complex is formed in all the cases in the pH range 2.5 to 3.5 and their stability constants are reported. (auth)

47130 PREPARATION OF URANIUM CARBONITRIDE BY REACTION OF UC WITH AMMONIA. Akimoto, Yumi; Tanaka, Koji (Mitsubishi Metal Mining Co., Ltd., Omiya, Japan). J. Nucl. Sci. Technol. (Tokyo), 5: 414-18(Aug. 1968).

With the view to establishing a method of directly converting uranium carbide into uranium carbonitride and hydrocarbons, an attempt was made to induce reaction between UC and ammonia under various temperatures from 25 to 600°C and pressures from 1 to 1,500 kg/cm^2. The reaction aimed at was realized to the extent of practical significance under pressures exceeding 500 kg/cm^2 at 450°C and exceeding 250 kg/cm^2 at 500°C. The hydrocarbons produced thereby were found to be mainly methane, indicating that the formula of the predominant reaction was $UC + NH_3 \rightarrow UN_{2-x} + CH_4 + H_2$. On heating the powdery fine black product to 1,800°C in vacuo, unexpectedly marked sintering was found to occur, resulting in dense uranium monocarbonitride without any compaction pretreatment. (auth)

47131 H/D ISOTOPE EFFECT IN THE CONVERSION OF THE ELECTRON INTO A HYDROGEN ATOM IN AQUEOUS ACID SOLUTIONS AT 300 AND 77°K. Ohno, Shin-ichi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Jap., 41: 1301-7(June 1968).

The isotope effect in the formation of hydrogen atoms as a result of the reaction of the photochemically produced electron in an acidified solution of hexacyanoferrate(II) was investigated in both the liquid and solid phases. The magnitude of the effect (H/D) in the liquid phase, determined by a mass-spectrometric analysis of the hydrogen gas evolved from CH_3OH-containing solution, ranges from 3 to 4, and it depends on the temperature. The corresponding H/D ratio in acidic ices (at 77°K), determined by comparing the relative intensities of the ESR signals of the H and D atoms, is rather low (~1.5). Possible mechanisms by which the electron is converted into a hydrogen atom in aqueous acid solutions in both phases are discussed. (auth)

47132 STRUCTURES OF SOLID DEUTERIUM ABOVE AND BELOW THE λ TRANSITION AS DETERMINED BY NEUTRON DIFFRACTION. Mucker, K. F.; Harris, P. M.; White, David; Erickson, R. A. (Ohio State Univ., Columbus). J. Chem. Phys., 49: 1922-31(Aug. 15, 1968).

Reproducible neutron diffraction patterns were obtained from samples of powdered deuterium with para (J = 1) concentrations equal to 3, 33, 63, and 80%. The diffraction patterns were obtained at various temperatures in the range 1.9 to 13°K and for the 80% sample at temperatures both above and below the λ anomaly in the heat capacity. The deuterium powdered samples were randomly oriented except for an estimated preferred orientation of 8% or less. All of the samples froze from the liquid to a hexagonal structure with the molecules at the close-packed sites. In the case of the 80% paradeuterium sample a transformation from the hcp structure to a cubic structure occurred at a lower temperature than has been observed for the λ anomaly in the heat capacity. Observations of the transformation between the hexagonal and cubic phases, on warming or cooling, have shown a large hysteresis effect. The cubic-phase diffraction patterns corresponded to space group Pa3 with four molecules per unit cell and a = 5.074 Å.

Absolute integrated intensities of the five observed lines were calculated and are in excellent agreement with observed values. The hexagonal-phase lattice parameters for the above samples are presented. An analysis of the integrated intensities of the six observed hexagonal lines indicated a disordered structure. Four of the five structural models under consideration gave an average site symmetry which is equivalent to that produced by a molecule precessing about the z direction with a mean precession angle δ. In general, δ was found to increase with increasing para concentration except for 63% paradeuterium, at 2°K, where a spherical average site symmetry (i.e., complete disorder) was indicated. (auth)

47133 DETERMINATION OF SPECIFIC SURFACE OF STRONTIUM SULPHATE BY ISOTOPIC ION EXCHANGE. Enuestuen, B. V.; Tunali, N. K. (Middle East Technical Univ., Ankara). Int. J. Appl. Radiat. Isotop., 19: 637-43(Aug. 1968).

A refined treatment was developed for the determination of specific surfaces of ionic solids from isotopic ion exchange data, which is particularly useful when the rate of self diffusion is comparable with the rate of exchange. Using $^{89}Sr^{2+}$ and $^{35}SO_4^{2-}$ as tracers, the kinetics of ion exchange of $SrSO_4$ were investigated at 25°C. On the basis of the proposed treatment, good agreement was obtained with the specific surface values as calculated from the exchange data of each ion. The discordant results of previous authors are explained in the light of the present study. Specific rates of exchange and self diffusion of both ions of $SrSO_4$ are also reported. (auth)

47134 HYDROLYSIS OF URANIUM MONOCARBIDE AND OXIDATION POTENTIALS. Hori, Yoshio; Mukaibo, Takashi (Tokyo Univ.). Bull. Chem. Soc. Jap., 41: 1983-9(Sept. 1968).

The hydrolysis of UC with 1N H_2SO_4 was carried out in the presence of various oxidants at 80°C. The amount of gaseous products was measured by means of a gas chromatograph; the dissolved, carbon-containing compounds, and the insoluble residues produced in the reaction were analyzed for carbon. Analyses of the uranium and oxidants consumed were also made by volumetric and gravimetric methods. The hydrolysis of UC with 1N H_2SO_4 proceeds by an electrochemical mechanism. The hydrolysis products fundamentally depend on the oxidation potential of the oxidants in the solution. The oxidation potential at which the hydrolysis of UC with 1N H_2SO_4 proceeds can be explained in terms of the partial ionic character of UC. The application of this experimental method to other carbides would serve to clarify the chemical reaction and the bond character of the carbides. (auth)

47135 EFFECT OF Sn AND Fe CHLORIDES ON BEHAVIOR OF IRRADIATED POLYOLEFINES AT ELEVATED TEMPERATURES. Berlyant, S. M.; Karpov, V. L.; Finkel, E. E. Vysokomol. Soedin., Ser. A, 10: 1899-1906(Aug. 1968). (In Russian).

As found by the thermomechanical method, rupture of irradiated samples of polyethylene containing tin chloride and ferric and ferrous chlorides occurs at much higher temperatures than without additives. The phenomenon is studied by different physicochemical methods. By means of DTA it was discovered that oxidation of the polymer containing chlorides of tin and iron proceeds at a higher temperature than of pure polyethylene. The mechanism of the strengthening effect of chlorides was proposed. (auth)

47136 TRANSFER AND EXCHANGE CONTRIBUTIONS TO SOLVENT ISOTOPE EFFECTS. Gold, V. (King's Coll., London). Trans. Faraday Soc., 64: 2143-5(Aug. 1968).

It was found that the transfer contribution to deuterium solvent isotope effects in water can be represented as an exchange effect. The introduction of a solute into water creates a change in solvent structure which can be written as a chemical reaction involving solvent hydrogen nuclei, and the isotope effect on the equilibrium constant of this reaction can then be expressed in terms of deuterium fractionation between different hydrogen sites. (auth)

47137 URANIUM CHALCOGENIDES. II. HEAT CAPACITIES AND THERMODYNAMIC PROPERTIES OF US_2 AND US_3 FROM 5 TO 350°K. Groenvold, Fredrik (Univ. of Oslo); Westrum, Edgar F. Jr. Contract AT(11-1)-1149. J. Inorg. Nucl. Chem., 30: 2127-33(Sept. 1968). (COO-1148-115).

Heat capacity measurements and calculations of thermodynamic properties were carried out for the compounds US_2 and US_3 from 5 to 350°K. The temperature dependence of the heat capacities is of normal sigmate type, except that for US_2 the rise in heat capacity in the region 10 to 20°K is more rapid than expected. Comparison of the US_2 data with those on US and US_3 indicates the presence of a Schottky-type transition in US_2 with a maximum of about 0.5 cal $mole^{-1}$ $°K^{-1}$ at 25°K. Values of the heat capacity (C_p), entropy ($S^0-S_0^0$), and Gibbs energy function $[-(G^0-H_0^0)/T]$ at 298.15°K are 17.86, 26.42, and 14.01 for US_2 and 22.85, 33.09, and 17.45 for US_3, respectively, in cal $mole^{-1}$ $°K^{-1}$. (auth)

47138 NONRADIATIVE TRANSFER OF EXCITATION ENERGY BETWEEN RARE-EARTH IONS IN AQUEOUS SOLUTION. Quiring, F. S. (Washington Univ., St. Louis). J. Chem. Phys., 49: 2448-9(Sept. 1, 1968).

This study is based on the assumption that the probability of energy transfer between rare earth ions would be enhanced if different ions were bound to the same ligand. Mixed trinuclear complexes of Tb and Eu were prepared using lactose as the ligand. The aqueous solutions with pH 8.0 to 8.4 were excited with light from a xenon lamp. Spectral studies indicated energy transfer between Tb^{3+} and Eu^{3+}. (J.G.B.)

47139 INFRARED AND RAMAN INVESTIGATION OF CONDENSED PHASES OF METHYLAMINE AND ITS DEUTERIUM DERIVATIVES. Durig, J. R.; Bush, S. F.; Baglin, F. G. (Univ. of South Carolina, Columbia). J. Chem. Phys., 49: 2106-17 (Sept. 1, 1968).

The infrared spectra of solid and matrix-isolated methylamine, methylamine-d_2, methyl-d_3-amine, and methyl-d_3-amine-d_2 were recorded from 4000 to 250 cm^{-1}. The Raman spectra of the four isotopic species were also recorded and depolarization values measured. The elusive NH_2 twisting vibration was located in the solid-phase infrared spectra of CH_3NH_2 and CD_3NH_2, and the assignment is in agreement with both the product rule and earlier assignments for this normal mode in hydrazine. A temperature-dependent hydrogen-bonding study has been carried out and ΔH^0 for H-bond formation in methylamine-d_2 was found to be −660 cal/mole.

47140 FAR INFRARED SPECTRA OF URANYL SALTS. Bist, H. D. (Indian Inst. of Tech., Kanpur, India). J. Mol. Spectrosc., 27: 542-4(Sept. 18, 1968).

The far infrared spectrum of uranyl nitrate hexahydrate is reported. The curve between the 100 to 300 cm^{-1} region was analyzed into 5 overlapping bands. The frequencies of the observed peaks were 120, 144, 165, 205, and 252 cm^{-1}. Values for the position, intensities, and halfwidths of bending vibration and its hot bands of UO_2^{++} ion in uranyl nitrate hexahydrate are tabulated. (D.H.M.)

47141 THE INFRARED SPECTRUM OF $^{12}C^{18}O_2$. Chackerian, Charles Jr.; Eggers, David F. Jr. (Univ. of Washington, Seattle). J. Mol. Spectrosc., 27: 59-71(Sept. 18, 1968).

Eight vibration-rotation bands of $^{12}C^{18}O_2$ and two of $^{13}C^{18}O_2$ were observed with 0.3 to 0.6 cm^{-1} resolution. Rotational constants obtained from the analysis are reported and discussed briefly. (auth)

47142 ELECTRIC FIELD INDUCED SPECTRA OF MOLECULAR HYDROGEN, DEUTERIUM AND DEUTERIUM HYDRIDE. Brannon, P. J. (Univ. of Tennessee, Knoxville); Church, C. H.; Peters, C. W. J. Mol. Spectrosc., 27: 44-54(Sept. 18, 1968).

The electric field-induced spectra of molecular hydrogen, deuterium, and deuterium hydride was observed in the pressure range of 0 to 600 psi. Thirteen lines each of the fundamental vibration–rotation band were observed for hydrogen and deuterium and nine were observed for deuterium hydride. A plot of line position versus density yielded zero pressure line positions. Molecular constants were derived from the zero pressure values. (auth)

47143 URANYL OXALATE COMPLEX WITH NN-DIMETHYLFORMAMIDE. Solovkin, A. S.; Indikov, E. M. Zh. Neorg. Khim., 13: 2028-9(1968). (In Russian).

A fine-grain, dense, yellow-green precipitate was obtained by adding oxalic acid to uranyl nitrate containing DMF (NN-dimethylformamide). Trilonometric and permanganometric analyses established the precipitate formula $UO_2C_2O_4 \cdot 3DMF$. At room temperature the $UO_2C_2O_4 \cdot 3DMF$ precipitate is slightly soluble in aqueous nitric acid solutions. (auth)

47144 STANDARD FREE ENERGY OF FORMATION OF UI_3 FROM EMF MEASUREMENTS ON A SOLID ELECTROLYTE GALVANIC CELL. Tveekrem, J. O.; Chandrasekharaiah, M. S. (Brookhaven National Lab., Upton, N. Y.). J. Electrochem. Soc., 115: 1021-3(Oct. 1968).

The first known experimental measurements of the ΔF_f^0 of UI_3 are described. The emf of the solid electrolyte galvanic cell, Pt/U,UI_3(s)/NaI(s)/AgI(s)/Ag(s)/Pt, was measured over the temperature range from 220 to 370°C. The ΔF values of the cell reaction U(s) + 3AgI(s) ⇌ UI_3(s) + 3Ag(s), derived from the emf data from six cells, were combined with the ΔF_f^0 values of AgI to obtain the ΔF_f^0 of UI_3. This resulted in a value of −98.8 ± 0.4 kcal/mole at 370°C, which was 6.7 kcal/mole more positive than previously published estimated values. (auth)

47145 REACTIVITY OF TRANSITION METAL FLUORIDES. V. REACTIONS OF HEXAFLUORIDES OF MOLYBDENUM, TUNGSTEN, AND URANIUM WITH IONIC CHLORIDES. O'Donnell, T. A.; Wilson, P. W. (Univ. of Melbourne, Victoria). Aust. J. Chem., 21: 1415-19(June 1968).

An investigation of the reactions of higher fluorides of transition elements with a range of covalent chlorides was extended to cover the reactions of the hexafluorides of Mo, W, and U with binary ionic chlorides. The products of reaction are tabulated. Chlorine was detected as a product of most reactions. Reaction of UF_6 with Sr and Ba chlorides was very slow. The compound $Mo_2Cl_3(MoF_6)_3$ occurred as the Mo-containing product in each of the reactions of molybdenum hexafluoride. Thermodynamic data available for the uranium halides were used to calculate the free energies for some possible reactions of UF_6. WF_6 appears inert by comparison with MoF_6. UF_6 is a sufficiently strong fluorinating agent to oxidize MoF_5 to MoF_6. UF_6 oxidizes AsF_3 while MoF_6 does not. However, this order of reactivity is reversed when considering halogen-exchange reactions, since UF_6 does not react as extensively as MoF_6 with chlorides that readily undergo halogen exchange. There are indications of this reversal in reactivity when considering reactions with covalent chlorides. (BBB)

47146 THE ^{36}Cl EXCHANGE REACTION BETWEEN GASEOUS HYDROGEN CHLORIDE AND PYRIDINE HYDROCHLORIDE AND GASEOUS HYDROGEN CHLORIDE AND HYDROCHLORIDE OF PICOLINIC ACID. Szydlowski, Jerzy; Wiech, Tadeusz; Zielinski, Mieczyslaw (Univ., Warsaw). Nukleonika, 13: 911-19(1968). (In Polish).

The kinetics of the ^{36}Cl exchange reaction between gaseous HCl and pyridine hydrochloride and between gaseous HCl and the hydrochloride of picolinic acid below the melting temperatures of the hydrochlorides were studied as a function of temperature. The time dependence of $\lg(1 - F)$ showed that at each temperature studied the process of isotopic exchange can be divided into two processes: the fast surface exchange reaction and the slow diffusion controlled exchange. The activation energies of the fast process and the slow process are different. The kinetic data indicate that the ^{36}Cl exchange rate is much slower in the case of picolinic acid hydrochloride, especially in the second diffusion controlled process. (auth)

47147 METHOD AND APPARATUS FOR DRYING PARTICULATE MATTER. Jansson, Robert Mauritz; Strandell, Erik Axel; Wik, Claes Gustaf (to Aktiebolaget Atomenergi). British Patent 1,127,051. Sept. 11, 1968. Priority date Dec. 7, 1964, Sweden.

A process is described for drying particulate material moist with an evaporable liquid, such as water, with particular application to the drying of slurries of U compounds obtained by precipitation. The material to be dried is formed into a cake in a drying container having a horizontal floor, and the cake is heated while a scraping member is moved in contact with the upper surface of the cake to loosen only the surface-adjacent particles from the surface. This scraping forms a loose powder mass on the upper surface of the cake. The scraper is successively lowered in the drying container as the level of the upper surface of the cake falls. (B.L.M.)

47148 INFLUENCE OF THE ALKALI HALIDES ON THE STRUCTURE OF WATER. Greyson, J. (North American Rockwell Corp., Canoga Park, Calif.). Desalination, 3: 60-5 (1967).

Differences in properties between heavy and normal water solutions, attributed to the extent to which the structure of the solvents is destroyed or enhanced by the dissolved species, were studied. The specific approach taken entailed an investigation of electrochemical cells in which heavy and normal water ionic solutions are separated by an ion-permeable membrane. EMF measurements of electrochemical cells containing D_2O and H_2O solutions of several alkali halides were made. The cell potentials were combined with available heat of solution data to determine the entropy of transfer of the salts between the isotopic solvents. From the values of the entropy of transfer, the order of the structure influencing properties of alkali cations and halide anions was found to be $K^+ > Na^+ > Li^+$ and $I^- > Br^- > Cl^- > F^-$. Differences in values among the ions indicated that structure-influencing properties are more sensitive to ion size for negatively charged species than for positively charged species. The negative values found for the entropy indicated that the salts are more structure-disrupting to D_2O than to H_2O. (BBB)

47149 APPLICATION OF NEUTRON DIFFRACTION TO THE STUDY OF THE CRYSTALLINE STRUCTURE OF URANIUM TRIFLUORIDE UF_3. Laveissiere, J. (Centre d'Etudes Nucleaires, Gif-sur-Yvette, France). Bull. Soc. Fr. Miner. Crist., 90: 304-7(July-Sept. 1967). (In French).

Two structures were proposed for UF_3: a hexagonal cell, $a' = 4.146$ Å, $c' = 7.348$ Å; and another containing 6U instead of 2 per unit cell, $a = 7.179$ Å, $c = 7.345$ Å. A neutron diffraction spectrum is illustrated and interpreted in an attempt to analyze this problem. Calculated and observed intensities are tabulated. The factor R for the groups $P\bar{3}c1$ and $P6_3cm$ is 5.7% in both cases; the partial factor R_I is 10.6% for $P6_3cm$ and 13.5% for $P\bar{3}c1$. This tends to support the former assignment, but the criterion is insufficient and only an experiment on a single crystal would resolve the point. An absolute measurement made on the two intense lines 300 and 113 did not yield any complementary information. (BBB)

47150 CHANGES OF THE STRUCTURE OF THE OXIDE U_4O_9. Belbeoch, B.; Boivineau, J. C. (CEN, Saclay, France). Bull. Soc. Fr. Miner. Crist., 90: 558-63(Oct.-Dec. 1967). (In French).

Due to the influence of crystallite size x-ray diffraction is sometimes a difficult method for detecting transitions when small deformations of the unit cell are involved. The oxide U_4O_9 has a cubic-rhombohedral transition at 65°C in the temperature range where specific heat and lattice expansion show an anomalous behavior. At 20°C $a = na_0 = n \times 5.4438$ Å, $\alpha = 90.078°$. At 1125°C a sharp gap in the unit cell parameter is observed and the superlattice lines disappear. An order-disorder transformation occurs at this temperature. The interpretation of an order-disorder transition at 900°C in the U_4O_9 domain based on tempering experiments is probably related to the same transition noted here at 65°C. Tempering is inefficient, and strains of thermal origin perhaps allow liberation of rhomohedral domains. It was not possible to determine whether the 1125°C transition occurs at constant composition. (BBB)

47151 ELECTRON SPIN RESONANCE OF IRRADIATED CAESIUM URANYL NITRATE. Lingam, K. V.; Venkataraman, B. (Tata Inst. of Fundamental Research, Bombay). Bull. Nat. Inst. Sci. India, No. 30, 28-30(1965).

Single crystals of cesium uranyl nitrate, $Cs(UO_2)(NO_3)_3$, on irradiation with electrons from a linear accelerator (average energy 3.5 MeV) have shown electron spin resonance, presumably arising from the NO_3 radical. The spectrum has an anisotropic g-value and the three lines observed for general orientation of the crystal with respect to the magnetic field are attributed to three identical radicals situated at three inequivalent positions with respect to the magnetic field. The three lines coalesce into a single line when the magnetic field is parallel to the c-axis. On irradiation with neutrons and γ rays, a similar spectrum was observed. (auth)

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Refer also to abstracts 47294, 47491, and 48774.

47152 (BMwF-FBK-68-10) THE ISOLATION OF ^{242}Cm IN THE 100-Ci REGION FROM NEUTRON-IRRADIATED ^{241}Am. Born, H.-J.; Hoehlein, G. (Technische Hochschule, Munich (West Germany). Institut fuer Radiochemie). Mar. 1968. 33p. (In German). Dep.

A process for the isolation of ^{242}Cm in the 100-Ci range was developed and tested. The separation apparatus for mechanical and chemical processing of a 200-mg sample of ^{241}Am irradiated in a high-flux reactor is remote-controlled and is continuously supervised by means of a gamma spectroscope. The Cm is separated from Am, Pu, and fission products on cation exchangers. The trivalent actinides and lanthanides are first absorbed on an exchanger column, and ^{103}Ru and ^{95}Zr, ^{95}Nb, and tetravalent $^{238,242}Pu$ are eluted as sulfato and oxalato complexes. ^{91}Y, ^{144}Ce, trivalent $^{238,242}Pu$, ^{241}Am, and ^{242}Cm are then separated on a larger column by an automatic pH-gradient elution technique with α-hydroxyisobutyric acid as the eluent. (auth)

47153 (COO-584-36) LOW ENERGY ELECTRON IRRADIATION OF SOLID ETHENE AT 63°K. Gill, P. S.; Moser, H. C. (Kansas State Univ., Manhattan, Dept. of Chemistry). [1967]. Contract AT(11-1)-584. 16p. Dep. CFSTI.

Films of solid ethene at 63°K were irradiated with electrons at 8.7, 18.7, 28.7, and 48.7 eV. The major products were H_2, C_2H_2, C_2H_6, $n\text{-}C_4H_{10}$, $1\text{-}C_4H_8$, and $2\text{-}C_4H_8$. The product yield increased sevenfold as the energy was increased from 8.7 to 48.7 eV, but the relative yields of the products remained constant at all energies. The two compounds C_2H_2 and C_2H_6 accounted for a little more than three-fourths of the hydrocarbon products. The presence of NO, at a mole fraction of 0.15 or more, greatly reduced the yields of C_2H_6 and $n\text{-}C_4H_{10}$ but had little effect on the yields of C_2H_2 and $2\text{-}C_4H_8$. Decomposition of excited ethene to form C_2H_2 and H_2 or 2H is proposed as the most important initial process. (auth)

47154 X-RAY DEGRADATION OF PENTON AND ITS POTENTIAL USE AS A DOSIMETER FOR THE 4 TO 15 keV RANGE. Mallon, Barbara J. (Univ. of California, Livermore). Contract W-7405-eng-48. J. Polym. Sci., Part A-1, 6: 2637-52(Sept. 1968). (UCRL-70728).

Exposure of poly-3,3-(bischloromethyl)oxetane (Penton) to x rays produces a linear reduction of the molecular weight, heat of fusion, and melting point with increasing absorbed dose. Optical density measurements fit a smooth curve with absorbed dose. Exposures were made with 25, 50, and 100 cal/cm^2 integrated incident energy at 50 peak kV with and without zinc and titanium–aluminum filters. Because the molecular weight of Penton is relatively uniform from lot to lot, and because it is difficult to obtain spectral measurement in the 4 to 15 keV range to which Penton is particularly sensitive, it is believed that the data contained in this report can be used with an iterative computer code to determine the spectrum and intensity of radiation in this region. (auth)

47155 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED TETRAETHYLAMMONIUM IODIDE. Fabes, L.; Wan, J. K. S. (Queen's Univ., Kingston, Ont.). Can. J. Chem., 46: 2749-52(Aug. 15, 1968).

Gamma irradiation of polycrystalline tetraethylammonium iodide at 77°K led to the breaking of a C–C bond and the primary radicals $\dot{C}H_3$ and $(C_2H_5)_3\dot{N}CH_2$ were detected by electron spin resonance. The methyl radicals were found to disappear readily at 120°K. In the range of 263 to 273°K a secondary reaction between $(C_2H_5)_3\dot{N}CH_2$ and the parent ion $(C_2H_5)_4\dot{N}$ was observed; the resulting secondary radical $(C_2H_5)_3\dot{N}CHCH_3$ was found to be stable up to 373°K. (auth) (UK)

47156 OBSERVATION OF GEL FORMATION IN PENTON WITH LOW-ENERGY X-RAYS. Mallon, Barbara J. (Univ. of California, Livermore). J. Polym. Sci., Part A-1, 6: 2677(Sept. 1968). (UCRL–70996).

Gel formation was observed in the surface disk, 0.0458 cm thick, of a stack of Penton disks irradiated with 50-pkV x rays at several total energy levels. These levels were 5 cal/cm^2, 10 cal/cm^2, 25 cal/cm^2, and an aluminum-filtered 20 cal/cm^2 with average absorbed doses of 35.0, 70.1, 131.7, and 111.7 cal/g, respectively. The amount of gel formed was approximately 10% by weight (slightly less in the aluminum-filtered specimen). No gel was found in the subsurface disks of exposures up to 100 cal/cm^2 total incident energy except for perhaps a trace in the second disk. The gel formation did not appear to be dose-dependent, but rather position-dependent, which means spectrum-dependent. The gel formation appeared to be a function of more intense excitation than is caused by higher energy x-rays or γ-rays. The intrinsic viscosity of the dissolved portion of the sample was measured, and a plot of $(1/[\eta])^{1/\alpha}$ as a function of absorbed dose was found to bear the same linear relationship as was obtained for specimens with no observable gel formation. This indicates that chain scission proceeds independently of gel formation. Melting point measurements bear the same linear relationship with absorbed dose with or without gel formation. The observation that heats of fusion of annealed samples have a linear relationship with absorbed dose in both surface and lower disks suggests that this amount of gel formation does not interfere, to an observable extent, with the ability of Penton to crystallize. (auth)

47157 SPATIAL DISTRIBUTION OF TRAPPED RADICALS IN γ-IRRADIATED ETHYLENE GLYCOL DIMETHACRYLATE POLYMERS. Zimbrick, John; Hoecker, Frank; Kevan, Larry (Univ. of Kansas, Lawrence). J. Phys. Chem., 72: 3277-80 (Sept. 1968).

Trapped radicals are produced in γ-irradiated ethylene glycol dimethacrylate gels. A nine-line EPR spectrum is observed which is identical with the spectrum seen in irradiated methyl methacrylate gels. Paramagnetic relaxation times as a function of radiation dose from 0.5 to 2 MRADS were measured by power-saturation methods. The spin–spin relaxation time is constant with dose and indicates that the radicals are trapped inhomogeneously in radiation-produced spurs in which the local radical molarity is several times greater than the average radical molarity. (auth)

47158 KRYPTON-RADIOSENSITIZED REACTION OF DEUTERIUM ATOMS WITH ETHYLENE. Tewarson, A.; Lampe, F. W. (Pennsylvania State Univ., University Park). J. Phys. Chem., 72: 3261-5(Sept. 1968).

The radioinduced reaction of deuterium with ethylene, sensitized by krypton, is shown to proceed by the addition of deuterium atoms to ethylene, followed by the reaction of thermalyzed ethyl radicals. Substantial yields of C_4H_{10} and of C_2H_5D show that unimolecular decomposition of initially formed $C_2H_4D^*$ is an important process. The variation of the relative yields of butane-d_0, -d_1, and -d_2 with D_2 pressure show that stabilization of $C_2H_4D^*$ relative to its decomposition is considerably smaller than is observed, when thermal D atoms are added to C_2H_4. It is thus suggested that the D atoms formed in the radiosensitized process are kinetically "hot." Yields of ethane in excess of that formed by disproportionation of ethyl radicals are best explained by the reaction of D atoms with ethyl radicals. (auth)

47159 ELECTRON SPIN RESONANCE OF γ-RAY PRODUCED ION RADICAL PAIRS IN A SINGLE CRYSTAL OF MALEIC ANHYDRIDE. Iwasaki, M.; Eda, B. (Government Industrial Research Inst., Nagoya, Japan). Chem. Phys. Lett., 2: 210-12 (Aug. 1968).

From the ESR measurements, it was found that positive and negative ions are trapped in pairs along the c axis with a separation of one unit in a γ-irradiated single crystal of maleic anhydride at 77°K. (auth)

47160 INFRA-RED METHOD IN STUDYING EFFECTS OF RADIOLYSIS ON STRUCTURAL CHANGES IN RUBBER AND EFFECTS OF SULFUR ON THESE CHANGES. Kozlov, V. T.; Klauzen, N. A.; Tarasova, Z. N. (Scientific-Research Inst. of Tire Industry, Moscow. Scientific-Research Inst. of Rubber Industry, Moscow). Vysokomol. Soedin., Ser. A, 10: 1649-55 (July 1968). (In Russian).

Structural transformations in rubbers on irradiation with ^{60}Co were studied by infrared spectroscopy at doses up to 100 Mrad. Addition of antioxidants and sulfur inhibits oxidation and decreases double bonds expenditure if irradiation is carried in air or in poor vacuum. Sulfur also decreases other structural changes (e.g., cis-trans isomerization). On radiolysis at lower oxygen content both oxidation processes and unsaturation expenditure are inhibited. Based on the absence of the disappearance of double bonds, a minor role for reactions of hot hydrogen atoms decreasing unsaturation is suggested. (auth)

47161 ELECTRODEPOSITION OF CARRIER-FREE ^{95}Zr FROM AN AQUEOUS BATH. Joshi, B. M.; Bhatki, K. S. (Tata Inst. of Fundamental Research, Bombay). J. Radioanal. Chem., 1: 331-6(July 1968).

The electrodeposition of carrier-free ^{95}Zr for nuclear spectroscopic studies was successfully achieved using a urea–oxalate electrolyte solution. Employing a current density of 40 mA per cm^2, over 80% of radioactive zirconium was deposited within 40 hours. Attempts to electroplate ^{95}Zr from aqueous baths containing various other inorganic and organic acids, bases, or their salts, were unsuccessful. (auth)

47162 ELECTRON SPIN RESONANCE IN X-IRRADIATED POTASSIUM SULPHATE. Hariharan, N.; Sobhanadri, J. (Indian Inst. of Tech., Madras). Curr. Sci. (India), 37: 400(July 20, 1968).

ESR spectral analyses of x-irradiated K_2SO_4 monocrystals at room and liquid nitrogen temperatures indicate the presence of several paramagnetic species, only four of which were tentatively assigned. (J.G.B.)

47163 RECOIL CHLORINE REACTIONS IN ALKYL CHLORIDE SYSTEMS. Wai, Chien Moo. Irvine, Calif., Univ. of California, 1967. 226p.

Thesis.

Recoil Cl species with extremely high energies were produced by three different nuclear transformation processes—$^{37}Cl(n,\gamma)^{38}Cl$, $^{40}Ar(\gamma,p)^{39}Cl$, and $^{35}Cl(\gamma,n)^{34m}Cl$. In cooling down to the chemical reaction range of about <20 eV, they will become neutralized as hot atoms in the ground state and provide a means of studying the chemistry of hot Cl atoms. The reactions of such hot Cl atoms were studied in several alkyl chloride systems and can be classified into three categories: substitution reactions; additions to double bonds; and abstraction reactions. The substitution of a recoil Cl atom for Cl at an asymmetric carbon atom of meso- or dl-2,3-dichlorobutane vapor proceeds with retention of optical configuration, indicating the mechanism of such bimolecular substitution reaction is a fast direct process without involving any long-lived intermediate. In the substitution of recoil Cl atom for H in 1-chlorobutane and 2-chlorobutane, the labeled dichlorobutane yields were proportional to the number of H atoms in the target molecule. However, significant deviations from the exact statistical value (±15%) were observed, suggesting that recoil Cl atom substitution for H may be sensitive to differences in C–H bond environments and perhaps to bond energies. The addition of a recoil Cl atom to the double bond of cis or trans-1,2-dichloroethylene forms an excited ·CHCl–CHClCl* radical, which will undergo unimolecular decomposition to eliminate a Cl atom, resulting in geometric isomerization. The pressure dependence of such an addition-elimination process was observed in CH_3Cl + 1,2-dichloroethylene vapor mixture indicating the life time of such an excited radical is of the order of 10^{-9} sec or longer. In the liquid phase, the "caging process" plays an important role in recoil Cl substitution reactions. Such atom-radical combination reactions are probably taking place on a time scale of 10^{-8} to 10^{-9} sec, comparable to the time required for racemization

of 2-chloro-sec-butyl radical or equilibration of CHCl = CH · radical. The kinetics of recoil Cl reactions has been studied in the gas phase CH_3Cl system. Kinetic analysis of the data obtained from the CH_3Cl + moderator system is in general consistent with the kinetic theory of hot atom reactions. Reactivity integrals and average logarithmic energy losses of recoil Cl reactions in this system were estimated. (Disser. Abstr.)

47164 ^{60}Co RADIOLYSIS OF AQUEOUS EOSIN. Rodde, A. F. Jr.; Grossweiner, L. I. (Michael Reese Hospital and Medical Center, Chicago). J. Phys. Chem., 72: 3337-9(Sept. 1968).

Initial G values for the decoloration of aqueous eosin by ^{60}Co γ rays in the presence of specific scavengers for hydrated electrons, H atoms, and OH radicals are reported. The presence of high sodium formate converts OH and H atoms to CO_2^-, which contributes to dye reduction. The spectral data show that in the presence of sodium formate the dye is bleached almost to completion with an early stage during which the absorption shifts to shorter wavelengths. However, bleaching was suppressed in the presence of high formate and high H_2O_2. The radiolysis of deaerated solutions or with e_{aq}^- scavengers such as H_2O_2, N_2O, or O_2 present led to a colored production reported by Patti (J. Chim. Phys., 52: 77(1955)). (D.H.M.)

47165 ABSTRACTION OF HYDROGEN ATOMS BY ENERGETIC TRITIUM ATOMS FROM NUCLEAR RECOIL. Tachikawa, Enzo. Irvine, Calif., Univ. of California, 1967. 283p.

Thesis.

Tritium atoms from nuclear recoil were allowed to react with various hydrocarbons or halocarbons in the presence of a large amount of moderator, perfluorocyclobutene. The energy loss process of the recoil atom are primarily controlled by the collisions with perfluorocyclobutene molecules, and thus the energetic tritium atom flux is reasonably similar in each of the systems, permitting a direct comparison of the HT yield from various R–H bond types. Yields of HT thus obtained from various reactants showed a good correlation with the dissociation energy of the C–H bond involved, with a higher yield from the weaker bonds. Similar correlation curves have also been obtained using different moderators, including perfluorocyclobutadiene, perfluoropropylene, Ar, and N_2. Using the established correlation between HT yield and C–H bond strength, estimates of the C–H bond strength in halomethanes and some ethylenic compounds have been obtained. The C–H bond strength in halomethanes generally decreases in the order: F, Br, and Cl, and furthermore, is usually reduced by the successive introduction of halogen atoms into the molecule. However, in the series of fluoromethanes, the C–H bond strength in CHF_3 is greater than that in CH_2F_2. The apparent bond dissociation energy of the primary C–H bond in propylene is estimated to be 4.08 ± 0.02 eV, substantially higher than all other estimates. This difference has been explained as the consequence of an impact time during abstraction of a H atom by recoil tritium not long enough for the C skeleton of propylene to be able to reach the most stable configuration of the allyl radical. Accordingly, less contribution of allylic resonance energy to the primary C–H bond is obtained, and the bond dissociation energy is higher than the "equilibrium" value corresponding to a fully resonant allyl radical. The C–H bond strengths in allene and trimethylamine were similarly determined to be 4.12 ± 0.02 and 4.03 ± 0.02 eV, respectively. (Disser. Abstr.)

47166 FORMATION OF CARBON DIOXIDE AND CARBON SUBOXIDE BY AN ENERGY TRANSFER PROCESS IN THE GAMMA RADIOLYSIS OF LIQUID AND SOLID CARBON MONOXIDE. Buschmann, H. W.; Groth, W. (Univ., Bonn). Chem. Phys. Lett., 2: 245-8(Aug. 1968).

The γ radiolysis of liquid and solid carbon monoxide–oxygen mixtures was investigated. In the liquid phase carbon dioxide, carbon suboxide, and ozone were observed as reaction products. The formation of carbon dioxide and of carbon suboxide was attributed to an energy transfer process. In the solid phase the formation of carbon dioxide and ozone was observed: the carbon dioxide was formed in part in an energy transfer reaction. (auth)

47167 RADIOLYSIS OF AQUEOUS SOLUTIONS OF DNA AND RELATED SUBSTANCES; REACTION OF HYDROGEN ATOMS. Scholes, George; Simic, Miomir (Univ. of Newcastle upon Tyne, Eng.). Biochim. Biophys. Acta, 166: 255-8(Aug. 23, 1968).

The reactivities of DNA and some related substances towards the hydrogen atoms formed by the radiolysis of water were investigated. Neutral or slightly alkaline solutions were irradiated with ^{60}Co gamma rays to total doses of approximately 2×10^{18} eV ml^{-1}. The H_2 yields from irradiated DNA solutions indicated that hydrogen atom attack occurs predominantly on the base components. (M.C.G.)

47168 KINETICS OF THE RADIOLYSIS OF POTASSIUM OXALATE AND OXALIC ACID. Murgulescu, I. G.; Contineanu, M. (Univ., Bucharest). Rev. Roum. Chim., 13: 661-9(June 1968).

The kinetics and mechanism of the potassium oxalate and oxalic acid decomposition on γ–^{60}Co irradiation have been studied. The overall rate constant for the decomposition reaction of the potassium oxalate has been determinated, indicating a second order kinetic law. The decomposition of the oxalic acid is a diffusion-controlled process as due to the different reaction mechanism in comparison with potassium oxalate. (auth)

47169 EFFECTS OF X- AND Γ-RAY RADIATION ON THE THERMAL DECOMPOSITION OF SOLID ORTHORHOMBIC AMMONIUM PERCHLORATE. I. EXPERIMENTAL AND RESULTS. Herley, P. J. (Picatinny Arsenal, Dover, N. J.); Levy, P. W. J. Chem. Phys., 49: 1493-1500(Aug. 15, 1968).

The thermal decomposition kinetics of unirradiated, x and gamma irradiated orthorhombic ammonium perchlorate have been determined in the temperature range of 193 to 238°C. Both millimeter size and powdered crystals were used. When all of the decomposition gases are allowed to collect, the pressure vs time curves consist of the following stages: first, an induction stage with a puff or burst superimposed on it; second, an acceleratory stage followed by a third, or decay, stage. When only the noncondensable gases, i.e., gases not condensed in a trap at −23°C or lower, are allowed to accumulate, the puff or burst, but not the induction period, is eliminated. Irradiation prior to decomposition reduces the induction period and increases the acceleratory period decomposition rate. Both of these effects increase as the dose is increased. If the decomposition is interrupted before the decay period, the sample irradiated with a fixed gamma dose, and the decomposition resumed, the following changes occur in the pressure vs time curves. First, the decomposition proceeds along the curve for unirradiated material but only for a constant period of time equivalent to the induction period for irradiated material. Second, at the end of this period, the decomposition rate abruptly increases to the approximate value obtained for irradiated material. The subsequent decay stage is similar to that observed with irradiated crystals. In addition to the kinetic studies the decomposition gases were analyzed with a mass spectrometer and preliminary measurements made on the low-temperature thermoluminescence of gamma irradiated material. (auth)

47170 EFFECTS OF X- AND Γ-RAY RADIATION ON THE THERMAL DECOMPOSITION OF SOLID ORTHORHOMBIC AMMONIUM PERCHLORATE. II. KINETICS AND DISCUSSION. Herley, P. J. (Picatinny Arsenal, Dover, N. J.); Levy, P. W. J. Chem. Phys., 49: 1500-9(Aug. 15, 1968).

The experimental data obtained by thermally decomposing unirradiated and irradiated orthorhombic ammonium perchlorate in the temperature range 193 to 238°C has been carefully analyzed. Most of this data consists of pressure vs time curves of the total evolved gas or that not trapped at −95°C or lower, obtained with powders and millimeter-size crystals. All of these curves can be described by the Avrami-Erofeyev equation. The increase in the acceleratory period rate, which is induced by, and is proportional to, x or γ irradiation prior to decomposition, can be attributed to the introduction of additional decomposition sites, an increase in the rate that each nucleus grows, or a combination of these. Independent microscopic examination of partially decomposed crystals also indicates that irradiation has increased the concentration of decomposition nuclei. In addition, the p vs t curve analysis shows that irradiation has increased the rate that potential decomposition sites are converted to active sites. The same activation energy, 28.4 ± 2.5 kcal $mole^{-1}$, was obtained for both the acceleratory and decay periods from irradiated and unirradiated crystals. Irradiation also increases the duration of the acceleratory period, shortens the decay period, and reduces the induction period. In fact, the induction period I for irradiated NH_4ClO_4 can be described by the relation $I = C_1 - C_2 \log(\text{dose})$. Taken together, these observations suggest that the same processes occur in both unirradiated and irradiated ammonium perchlorate, but the rate constants are increased by prior irradiation. (auth)

47171 ELECTRON SPIN RESONANCE STUDY OF THE RADIOLYSIS OF MONOCARBOXYLIC ACIDS ADSORBED ON SILICA GEL. Miura, Masaji; Hasegawa, Akinori; Yamada, Yoshio (Hiroshima Univ.). Bull. Chem. Soc. Jap., 41: 1320-3(June 1968).

Electron spin resonance measurements were carried out on γ-irradiated monocarboxylic acids (formic, acetic, and propionic acids) adsorbed on silica gel. In the case of formic acid, the spectrum assigned to the CO_2^- radical was mainly observed, but also observed was the signal caused by the defects of γ-irradiated silica gel, whereas for the acetic acid a quartet due to the methyl radical was obtained. These spectra, however, were not found in the frozen acids alone. As regards propionic acid, ethyl radicals were produced in both the adsorbed and frozen states. It

was concluded from these results that the characteristic radiolysis of monocarboxylic acids on the adsorbed state is to be attributed to interaction between the acids adsorbed on silica gel as monomers and the surface. On the basis of these spectra, the adsorbed state of the acids and the stability of the radicals are discussed. (auth)

47172 ABSORPTION SPECTRUM OF GAMMA-IRRADIATED POLY(METHYLMETHACRYLATE) WITHIN THE RANGE 245 TO 450 mμ. Fleming, R. J. (Monash Univ., Clayton, Victoria). Polymer, 9: 489-500(Sept. 1968).

The absorption spectrum was studied at room and liquid nitrogen temperatures. The materials used varied considerably in nature and concentration of initiator and chain-transfer agent additives. Most of the samples irradiated at liquid nitrogen temperature showed peak absorption wavelengths very close to those noted after room-temperature irradiation; a few showed shorter peak wavelengths, which shifted to the room-temperature values when subsequently warmed to room temperature. A marked dependence of spectral behavior on both initiator and chain-transfer agent content was noted, indicating that most of the absorbing species originate in the additives; on the other hand, an absorption peak around 252 mμ was found in several samples independent of their additive content, and also independent of the temperature of irradiation. It is postulated that the species giving rise to this particular absorption is formed on methylmethacrylate monomer residue in the polymer. Evidence is presented to show that the absorbing species are not radicals. It is possible that they are ionic in nature, probably cations. It is postulated that the absorbing species is a carbanion $-\ddot{C}HCH=CH-$ which, with appropriate electron pairing, would not give rise to an esr signal. Of the materials polymerized with the help of additives, those containing fairly large concentrations of mercaptan compounds as chain-transfer agents showed a slowly decaying absorption peaking around 252 mμ at liquid nitrogen temperature and 255 mμ at room temperature; the species giving rise to this absorption is to be distinguished from that formed on monomer residue. Materials containing benzoyl peroxide initiator showed peak absorption values around 280 and 290 mμ, independent of temperature. (auth) (UK)

47173 THERMAL DISINTEGRATION OF AMMONIUM PERCHLORATE DURING X-IRRADIATION. Skorik, A. I.; Boldyrev, V. V.; Komarov, V. F.; Baranov, A. I. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 11: 744-7(1968). (In Russian).

It was found that exposure to x radiation during the disintegration process increased the rate of decomposition of ammonium perchlorate with NiO, Ni_2O_3, and Co_3O_4 impurities. However, the kinetics of the degradation process in pure ammonium perchlorate and ammonium perchlorate with CdO, CdS, Fe_2O_3, CuI, PbO, WO_3, and MoO_2 impurities were not affected by x irradiation. (R.V.J.)

47174 EFFECTS OF IONIZING RADIATIONS ON WOOL. PART I. SOLUBILITY IN ALKALIS, ACIDS, UREA, AND UREA-BISULFITE SOLUTIONS. Marzona, M.; Di Modica, G. (Univ., Turin). Text. Res. J., 38: 974-6(Sept. 1968).

Solubility data for wool, irradiated in the presence of N_2 or O_2 using ^{60}Co γ rays, in alkalis, acids, urea, and urea–bisulfite are reported. The mechanics of the reaction between alkalis or urea–bisulfite and wool consisted substantially in a breakdown of the cross linkage between polypeptide chains with formation of low-molecular weight soluble fragments. Samples irradiated in the presence of O_2 were more soluble than the samples irradiated in the presence of N_2 in both urea–disulfite and alkalis. The action of radiation ceased above 20 megaRADs and the solubility of the two series remained nearly the same. The solubility in 0.01 N HCl, which in these conditions seems not to hydrolyze peptide bonds, but to disrupt only acid-labile cross-linkages, was also considered. The wool irradiated in the presence of O_2 or N_2 was almost insoluble in urea. (D.H.M.)

47175 RADIATION CHEMICAL SYNTHESIS OF ORGANO-PHOSPHORUS COMPOUNDS. I. PRODUCTS OF RADIO-CHEMICAL SYNTHESIS OF HYDROCARBONS MIXTURES WITH PHOSPHORUS TRICHLORIDE. Babkina, E. I.; Vereshchinskii, I. V. (Karpov Scientific Research Inst. of Physics and Chemistry). Zh. Obshch. Khim., 38: 1772-6(1968). (In Russian).

The radiation-chemical synthesis of compounds from cyclohexane and hexane mixtures with phosphorus trichloride irradiated with ^{60}Co γ rays produced previously unknown compounds of cyclohexenyl-, hexenyltetrachlor-, and dicyclohexyldichlorodiphosphines. (R.V.J.)

47176 IONIC PROCESSES IN THE RADIOLYSIS OF NITROUS OXIDE. Takao, Satoshi; Shida, Shoji; Hatano, Yoshihiko; Yamazaki, Hideo (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 41: 2221(Sept. 1968).

Nitrous oxide was irradiated with ^{60}Co gamma rays at 25°C to a total dose of 7.2×10^{20} eV g^{-1}. The products, N_2 and O_2, were analyzed by gas chromatography. The effects of electron scavengers and electron suppliers were investigated. (M.C.G.)

47177 HYDROGEN CYANIDE FORMATION IN THE GAS-PHASE RADIOLYSIS OF MIXTURES OF NITROGEN AND ETHYLENE. Oka, Takefumi; Kato, Ryo; Sato, Shin; Shida, Shoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 41: 2192-3(Sept. 1968).

The radiolysis of gaseous mixtures of nitrogen and ethylene was investigated in an attempt to study the reactions of nitrogen atoms with ethylene molecules. The samples were irradiated with ^{60}Co gamma radiation in sealed glass 80-ml vessels. G-values for hydrogen cyanide, the only observed product containing nitrogen atoms, were measured under a variety of conditions. It was concluded that the HCN is formed by the reaction of active species from nitrogen with ethylene. The G-value for the active species was estimated to be 0.8. (M.C.G.)

47178 HYDROGEN PRODUCED BY THE HOT-ATOM-PROCESS IN THE RADIOLYSIS OF ETHANE. Inoue, Masao; Uno, Taiko; Sato, Shin; Shida, Shoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 41: 2005-7(Sept. 1968).

The mechanism of formation of "molecular" hydrogen in ethane radiolysis at 300 torr was studied with ethane-ethane-d_6-ethylene mixtures. The G-value of the hydrogen was found to be 3.3. The addition of electron and positive ion scavengers scarcely affected the formation of the hydrogen at all. From the isotopic composition of the hydrogen, it was demonstrated that most of the hydrogen is formed by molecular detachment from the ethane molecule, while the rest is formed by the abstraction of a hydrogen atom from the ethane molecule by a hot hydrogen atom; the G-value for this is estimated to be 0.6. (auth)

47179 EFFECT OF MOISTURE ON REDUCTION OF ANTHRAQUINONE DERIVATIVES OF ^{60}Co γ-IRRADIATION. Yasukouchi, Kazuo; Yamaguchi, Hiroko; Maeda, Masanobu (Univ. of Kumamoto, Japan). Nippon Kagaku Zasshi, 89: 860-3(Sept. 1968). (In Japanese).

It is established that effect of moisture on polarographic reduction of anthraquinone derivatives makes the reduction potentials of the first and the second waves to shift to more positive, and makes wave height to decrease. The mechanism of reduction of quinone in non-aqueous solution which includes a little amount of water is considered as follows, (A): $Q \overset{+e}{\rightleftharpoons} Q^- \overset{+e}{\rightleftharpoons} Q^{2-} \xrightarrow{+2H^+} QH_2$ (B): $Q \overset{+e}{\rightleftharpoons} Q^- \xrightarrow{+H^+} Q\text{-}H \overset{+e}{\rightleftharpoons} Q\text{-}H^- \xrightarrow{+H^+} QH_2$. The effect of moisture (0 to 20 vol % range) on the mechanism of reduction by γ-ray irradiation in DMF solution was investigated. The results showed that with the increase of total dose, the wave-heights of two reduction waves were decreased and the reduction potential of the second wave shifted to positive for each water content. In addition, at large water content, the potential of the first wave shifted to positive, too. The results suggest that, the reduction took simultaneously the courses (B) and (A) in the presence of water at γ-ray irradiation, and the course (B) was preferred under the irradiation; the effect of substituents on electronation and hydrogenation was not changed by the γ-ray irradiation but by the addition of water; the effect of hydrogen peroxide formation from DMF could be disregarded; and the rate constant of the reduction by γ-ray irradiation increased with the water content, and it became large when the –E effect of substituents was large. (auth)

47180 ABOUT CARBONIUM MECHANISM OF RADIATION POLYMERIZATION OF ISOBUTYLENE. Popova, A. I.; Sheinker, A. P.; A'kin, A. D. (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Vysokomol. Soedin., Ser. A, 10: 1735-9(Aug. 1968). (In Russian).

The carbonium mechanism of radiation polymerization of isobutylene was considered on the basis of earlier experimental data. According to the mechanism development of ionic chains in the presence of solid additives is related to counter-ion fixing on the solid surface. In solution polymerization the decisive role belongs to solvation of carbonium ion by solvent molecules and reactions in volume may occur. Termination rate in copolymerization of isobutylene with styrene depends on this counter-ion nature. (auth)

47181 THERMAL ANNEALING IN NEUTRON-IRRADIATED TRIBROMOBENZENES. Siekierska, K. E. (Danish Atomic Energy Commission Research Establishment, Risoe); Halpern, A.; Maddock, A. G. J. Chem. Soc., A, No. 7, 1645-51(1968).

The distribution of ^{82}Br among various products in neutron-irradiated isomers of tribromobenzene was investigated, and the effects of thermal annealing examined. Reversed-phase partition chromatography was employed for the determination of radioactive organic products, and atomic bromine in the crystals was estimated by means of the 1,2-dibromoethylene exchange technique.

The results suggest that, as a consequence of nuclear events, quite a number of different reactions occur, whereas the principal annealing reaction is a recombination of atomic bromine with a dibromophenyl radical. (auth) (UK)

47182 WOLNE RODNIKI W CHEMII RADIACYJNEJ. (Free Radicals in Radiation Chemistry). Kroh, Jerzy. Seria Wydawnicza, Polskiego Towarzystwa Chemicznego, Monografie. Chemia Wspolczesna. Tom XII. Warszawa, Panstwowe Wydawnictwo Naukowe, 1967. 411p. Zl 55,-.

A brief review is given of free radicals and of the radiation chemistry of organic and inorganic compounds. Methods for free radical production, detection, and studies are described. Stabilization of free radicals at low temperatures, radiation chemistry of water and aqueous solutions, free radicals in gases and radiolysis of hydrocarbons are discussed. Free radicals in radiation polyreaction processes, radioinduced polymerization, and graft polymerization are considered. The principles of nuclear and electron paramagnetic resonances, NMR and EPR spectroscopy, and electron spin resonances are also covered. Each chapter includes a comprehensive list of references. (R.V.J.)

47183 INFLUENCE OF GAMMA RADIATION ON POLYTETRAFLUOROETHYLENE. Ferse, A.; Wuckel, L.; Koch, W. (Institut fuer Silikon-und Fluorkarbonchemie, Dresden). Kolloid Zh., 224: 33-5(May 1968). (In German).

The apparent G-values for γ-induced degradation of polytetrafluoroethylene resin in the presence of air and in vacuo were estimated as 5.6 and 0.17, respectively. These values were determined on the basis of changes in molecular weights calculated from standard densities. Densities and crystalline content were also determined by an ir technique. In air the crystallinity rose after doses greater than 10^4 rad were applied, going as high as 90% near 10^6 rad. In vacuo the density and crystallinity did not rise until doses were 10^8 rad or greater. The void content after irradiation was also determined: after 5×10^5 R, 0.26%; 1×10^6, 0.57%; 2×10^6, 0.96%; 4×10^6, 1.41%. The mechanism of the reaction is discussed. (BBB)

47184 STUDIES ON AZULENES. [Part] IV. IRRADIATION EFFECT OF RADIANT RAYS ON AZULENES. THE ULTRAVIOLET RADIATION ON GUAIAZULENE. Otani, Yasushi (Konan Kako Co., Ltd., Japan). Yakugaku Zasshi, 88: 802-6 (July 1968). (In Japanese).

Irradiation of guaiazulene with uv ray gave approximately the same result as that with γ rays. The absorption decreased in proportion to the time of irradiation, and guaiazulene in the solution was reduced to di-, tetra-, hexa-, octa-, and deca-hydroguaiazulene. At the same time, due probably to the effect of dissolved air, formation of an oxide as pale yellowish brown crystals and polymerization were found to take place. There was no marked change in the absorption spectrum even when the solution was stored at a room temperature for six mo or when a considerable amount of air was bubbled. The solution through which N_2 had been bubbled showed no formation of crystals even on irradiation of γ rays. These results indicate that discoloration of azulenes by irradiation of radioactive rays was due to the reduction and polymerization of azulene, and oxidation by dissolved air in the solution. (NSA of Japan)

47185 PROCESS FOR MANUFACTURING FIBRES OR FILMS FROM POLYVINYL ALCOHOL GRAFT-COPOLYMERIZED WITH ACRYLONITRILE. (to Kurashiki Rayon Kabushiki Kaisha). British Patent 1,126,975. Sept. 11, 1968. Priority date Apr. 21, 1965, Japan.

A spinning dope for fiber or film production contains not less than 5 wt % of a graft copolymer or polyvinyl alcohol (or a copolymer of vinyl alcohol with another vinyl monomer) with acrylonitrile. The polymerization is effected by conventional means employing a catalyst or radiation to yield the copolymer containing from 30 to 200 wt % of acrylonitrile based on the weight of the polyvinyl alcohol. The copolymer is dissolved in an aqueous salt solution containing one or more of the following salts: $ZnCl_2$, $AlCl_3$, $CaCl_2$, $MgCl_2$, KCNS, NaCNS, NH_4CNS, and CaCNS. (B.L.M.)

47186 MEASUREMENT OF CYTOCHROME c AND CYTOCHROME-LINKED ENZYME REACTIONS DURING X-IRRADIATION. Riley, Richard Charles. Ann Arbor, Mich., Univ. of Michigan, 1967. 117p.

Thesis.

Experiments were performed to determine whether cytochrome c is susceptible to immediate and transient oxidation or reduction during exposure to 50 kVp x rays. Measurements were made with cytochrome c in aqueous solution and while undergoing enzymatic reduction. An apparatus is described that permits continuous measurement of visible absorbance before, during, and after x irradiation. All measurements were made at 550 mμ. Ferricytochrome in aqueous solution undergoes reduction in the presence or absence of O at dose rates from 22 RADs/sec to 240 RADs/sec. During prolonged exposure absorbance increases rapidly at first and then decreases more slowly. The initial rate of reduction is proportional to dose rate in the range studied. Reduction starts within the first 2 sec of exposure and is an immediate effect as defined. Because the reduction produced by x rays persists after a 1 min exposure, it is not a transient effect of radiation. The initial rate of reduction is increased in the absence of O due to elimination of competition for e^-_{aq} by dissolved O. Radiation produced H_2O_2 is not involved in the overall radiation-reduction process. Oxidation of ferrocytochrome is also an immediate, nontransient effect of x radiation. The presence of a chemical reductant during irradiation enhances the rate of oxidation obtained during irradiation when compared to catalytically reduced cytochrome. Both D- and L-cysteine and MEG afford protection to ferricytochrome during irradiation. The reaction rates of the enzymes cytochrome c reductase and yeast lactate dehydrogenase are immediately and transiently decreased during irradiation at 60 RADs/sec. Under these conditions the cytochrome c reductase reaction rate during irradiation is 55% of its control and the yeast lactate dehydrogenase reaction rate is 9% of its control. The results are discussed in terms of an Energy Interruption Hypothesis for radiation damage in cells. (Disser. Abstr.)

47187 FREE RADICAL YIELDS IN POLYTETRAFLUOROETHYLENE AS THE BASIS FOR A RADIATION DOSIMETER. Judeikis, Henry S.; Hedgpeth, Herbert; Siegel, Seymour (Aerospace Corp., El Segundo, Calif.). Radiat. Res., 35: 247-62(1968).

Exposure of polytetrafluoroethylene (PTFE) to ionizing radiation results in chemical degradation of the polymer and formation of long-lived free radicals. The use of quantitative measurements of the electron spin resonance (ESR) spectra of the free radical produced in irradiated PTFE to determine radical yields and attempts to correlate these radical yields with the absorbed radiation dose is described. The experimental results indicated sufficient correlation over the experimental range from 10^4 to 10^8 RADs to permit use of PTFE as a passive radiation dosimeter. Analysis of the data indicated that, with minor modifications, the useful range could be extended to $<10^2$ to $>10^9$ RADs with uncertainties $\leq$15% when the dosimeter was calibrated with a known dose. The advantages inherent in the use of the PTFE dosimeter for the measurement of low-energy electromagnetic or particulate radiation are also discussed. Energy deposition as a function of depth from the incident surface could be determined by sectioning of the polymer after irradiation. The resulting dose-depth curves could then be used to obtain spectral and spatial distribution data from polychromatic sources. (auth)

47188 METHOD FOR PRODUCING A FOAMED MATERIAL WITH INDIVIDUAL FOAMS. Yamaguchi, Kenji (to Toyo Rayon Co., Ltd.). Japanese Patent 1968-6151. Mar. 6, 1968. Filed Mar. 9, 1964.

One or two kinds of natural or synthetic rubber, and a foaming agent are admixed with polyethylene. Then, the mixture is irradiated with ionizing radiation. Finally, it is heated continuously under atmospheric pressure, to bring about foaming. (NSA of Japan)

47189 METHOD FOR IRRADIATING MATERIALS. Suzuki, Satoshi (to Hitachi Chemical Industry Co., Ltd.). Japanese Patent 1968-7519. Mar. 21, 1968. Filed Mar. 7, 1964.

A method is proposed for uniform irradiation of a plastic material in the form of a cord without giving tension to the cord. This results in the improvement of its heat resistance, antisolvent, mechanical properties, etc. The irradiation takes place continuously as the cord is wound from one roller to another and back again to irradiate both sides of the cord. If the cord is too stiff, heat is applied to soften it for winding. (NSA of Japan)

47190 METHOD FOR PRODUCING IMPROVED POLYOXYMETHYLENE COPOLYMER. Ishida, Shinichi (to Asahi Chemical Industry Co., Ltd.). Japanese Patent 1968-4874. Feb. 22, 1968. Filed Dec. 28, 1963.

The polyoxymethylene copolymer is obtained by polymerizing trioxane and maleic anhydride and/or itaconic acid anhydride by means of ionizing radiation. The resultant polymer is treated with amine, ammonia, or hydrazine, or their derivatives. The copolymer obtained by this method has high thermal stability and superior whiteness. (NSA of Japan)

47191 METHOD FOR POLYMERIZING ETHYLENE WITH RADIATION IN PECULIAR WAY. Gotoda, Masao (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-9067. Apr. 12, 1968. Filed Dec. 12, 1964.

Ethylene can be polymerized simply in a wide range of density, with a high G-value sufficient for industrial processes by a first

irradiation at a high dose rate, and then a second at a low dose rate, to obtain an over-all high G-value. (NSA of Japan)

47192 METHOD FOR POLYMERIZING CYCLIC ETHER IN THE PRESENCE OF MALEIC ACID ANHYDRIDE. Takakura, Koichi (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-8829. Apr. 8, 1968. Filed Nov. 8, 1963.

Polymerization of a cyclic ether in the presence of maleic anhydride by means of ionizing radiation, uv radiation, or the action of a radical initiator yields a polymer and a copolymer. (NSA of Japan)

47193 METHOD FOR PRODUCING POLYMERS. Sagane, Norio (to Sekisui Chemical Co., Ltd.). Japanese Patent 1968-9070. Apr. 12, 1968. Filed Dec. 15, 1964.

A method is proposed for producing a polymer of acrylamide or methacrylamide having a high workability and a high water-resistance. The powder of acrylamide (or methacrylamide) is dispersed in a liquid material, which hardly dissolves the monomer but is capable of copolymerizing with it. Then, it is irradiated with ionizing radiation, to bring about the polymerization. Finally a polymer of the monomer, and a copolymer of the monomer and the liquid material are separated out, respectively, from the mixture. (NSA of Japan)

47194 METHOD FOR PRODUCING THERMOPLASTIC GRAFT COPOLYMERS. Watanabe, Tsutomu (to Sumitomo Bakelite Co., Ltd.). Japanese Patent 1968-4869. Feb. 22, 1968. Filed Dec. 16, 1963.

A thermoplastic graft copolymer is produced by mixing the three components given below making them into an aqueous emulsion, and then irradiating the emulsion with high-energy radiation: vinyl chloride polymer or a copolymer containing vinyl chloride; isobutylene polymer or a copolymer containing isobutylene, or butadiene or a copolymer containing butadiene; and one or more monomers, of aromatic vinyl, acryl, etc. The thermoplastic products obtained by this method have excellent mechanical properties, including shock resistance, tensile strength, etc., and also have high workability. (NSA of Japan)

47195 METHOD FOR PRODUCING A POLYFLUOROOLEFINE-DISPERSED LIQUID OF HIGH STABILITY AND HIGH CONCENTRATION. Yoneya, Minoru (to Daikin Industry Co., Ltd.). Japanese Patent 1968-4866. Feb. 22, 1968. Filed May 18, 1963.

A method is described for the production of a highly stable polyfluoroölefin-dispersed liquid with a high concentration. The emulsion polymerization of fluoroölefin(s) in an aqueous medium in the presence of a dispersion agent of the highly fluorinated (or highly fluorinated and chlorinated) alkyl system is carried out under the polymerization condition of carbon number over 12, with liquid hydrocarbon addition, and irradiation with ionizing radiation. (NSA of Japan)

47196 METHOD FOR PRODUCING THE HEAT-RESISTANT MOLDINGS OF RESINS OF THE POLYVINYL CHLORIDE SYSTEM. Yoshitake, Toshihiko (to Kurashiki Rayon Co., Ltd.). Japanese Patent 1967-24181. Nov. 21, 1967. Filed Mar. 5, 1964.

A resin of the polyvinyl chloride system, in the form of powder, is irradiated with ionizing radiation. This is contacted, so as not to destroy the powder form, with an alcohol solution of acrylonitrile, or a vinyl-system unsaturated monomer containing mainly acrylonitrile, to bring about a graft polymerization. The product obtained, with a grafting ratio below 200%, is molded into a desired shape. (NSA of Japan)

47197 REACTIONS OF FREE RADICALS IN POLYMER CHEMISTRY. Ranby, Bengt (Royal Technical Univ., Stockholm). Sv. Kem. Tidskr., 79: 365-78(1967). (In Swedish).

Some concepts of free radical formation in polymer synthesis are defined and discussed. The study of transient free radicals by electron spin resonance (ESR) measurements is outlined. Examples of ESR applications are given for additional polymerization by radical mechanisms and for degradation of polymers by uv and γ irradiation. The C–H, C–O, C–C, and C–N bond energies and uv quanta at various wavelengths for splitting various bonds are tabulated. The ESR spectra of irradiated polyethylene are shown. Effects of the presence of oxygen and the formation of peroxide radicals are explained. (BBB)

47198 GAS-PHASE PHOTOLYSIS AND RADIOLYSIS OF CYCLOPROPANE. Scala, A. A.; Ausloos, P. (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 49: 2282-90 (Sept. 1, 1968).

The gas-phase photolysis of c-C_3H_6–O_2, c-C_3H_6–NO, and c-C_3H_6–H_2S mixtures was investigated at 1470 Å (8.4 eV), 1236 Å (10 eV), and at 1048 to 67 Å (11.6 to 11.8 eV), that is, at photon energies below and above the ionization energy of cyclopropane (I. E. = 10.06 eV). Examination of the products formed in the gas-phase experiments at 1470 and 1236 Å as well as of those formed in a few solid-phase photolysis experiments indicate that the major primary act of the neutral excited cyclopropane molecule can be written c-$C_3H_6 + h\nu \rightarrow CH_2CH_2CH_2^*$. The highly excited trimethylene decomposes by the following two processes; (a) $CH_2CH_2CH_2^* \rightarrow C_3H_4 + CH_2$ and (b) $CH_2CH_2CH_2^* \rightarrow C_3H_4 + 2H$. There is, however, also evidence for rearrangement $CH_2CH_2CH_2^* \rightarrow CH_3CHCH_2^*$ which, at low densities, is always followed by fragmentation of $CH_3CHCH_2^*$. The primary process c-$C_3H_6 + h\nu \rightarrow H_2 + C_3H_4$ is of negligible importance, but detachment of H atoms before or after ring opening does occur, and increases in importance, at higher energies. At 1236 Å the quantum yield of excited cyclopropane molecules which decomposes is within experimental error equal to unity. In the photoionization region alkyl radicals such as C_2H_5 and $CH_3CH_2CH_2$ which were entirely absent at the lower energies are formed. These alkyl radicals which are also formed in the radiolysis are ascribed to ion–molecule reactions involving $C_3H_6^+$. Photoionization and radiolysis of c-C_3H_6–NO mixtures yielded evidence for the occurrence of the charge transfer processes: $C_3H_6^+ + NO$ [or $(CH_3)_3N$] $\rightarrow C_3H_6 + NO^+$ [or $(CH_3)_3N^+$] and $(NO^+)^* + $ c-$C_3H_6 \rightarrow C_3H_6^+ + NO$, where $(NO^+)^*$ is a vibrationally excited NO^+ ion. The $C_3H_6^+$ ions involved in these events ultimately yield propylene as a neutral product. (auth)

47199 γ RADIOLYSIS OF LIQUIDS AT HIGH PRESSURES. VI. HYDROGEN-ATOM REACTIONS IN AQUEOUS 0.8N H_2SO_4 SOLUTIONS. Hentz, Robert R.; Farhataziz; Milner, David J. (Univ. of Notre Dame, Ind.). J. Chem. Phys., 49: 2153-7(Sept. 1, 1968). (COO-38-594).

The competition between the reactions [1] H + S → no H_2, and [2] H + RH → H_2 + R, in aqueous 0.8N H_2SO_4 solutions was studied at 20°C over the applied pressure range of 0 to 6.34 kbar by measurement of $G(H_2)$ from the γ-irradiated solutions. With O_2 as S, in aerated solutions, relative specific rates k_1^H/k_2^H were determined at atmospheric pressure for methanol, glucose, glycerol, ethanol, and isopropanol as RH. From the pressure dependence of k_1/k_2 and an estimated $\Delta V_1^\ddagger = 1.6$ ml mole^{-1} for S ≡ O_2, values of $\Delta V_2^\ddagger$ in the range –5.5 to –6.7 ml mole^{-1} are obtained for the five H donors. The average value $\Delta V_2^\ddagger = -5.9$ ml mole^{-1} is taken as characteristic for reaction [2]. Values of k_1^H/k_2^H at atmospheric pressure also were determined for four deaerated 0.8N H_2SO_4 solutions: (1) RH ≡ glucose and S ≡ benzyl alcohol; (2) RH ≡ glucose and S ≡ $BrCH_2COOH$; (3) RH ≡ S ≡ acetone; (4) RH ≡ S ≡ $ClCH_2COOH$. Because little or no pressure dependence of $G(H_2)$ and, therefore, of k_1/k_2 was observed with these four solutions, $\Delta V_1^\ddagger \approx \Delta V_2^\ddagger = -5.9$ ml mole^{-1}. Thus, for a variety of H-atom reactions, which are not diffusion controlled, the value of $\Delta V^\ddagger$ is approximately constant. From this result a value of $\overline{V}(H)$ in the range 5.9 to 10.3 ml mole^{-1} is estimated. It also is concluded that abstraction of Br or Cl by H occurs, rather than electron transfer, in reaction [1] with $BrCH_2COOH$ or $ClCH_2COOH$ as S, respectively. Anomalous results obtained in a deaerated 0.8N H_2SO_4 solution of glucose and allyl alcohol are discussed. (auth)

Radiochemistry

47200 FREE RADICALS FORMED IN CYTOSINE-5-^{3}H BY DECAY OF THE CONSTITUENT TRITIUM ATOM. Benson, Brent; Snipes, Wallace (Pennsylvania State Univ., University Park). J. Chem. Phys., 49: 1435-6(Aug. 1, 1968).

The products of T decay at the 5-position in cytosine were studied by ESR techniques. The data indicate the formation of greater than one radical for every two decays. A structure for the free radical is proposed. (B.L.M.)

Separation Processes

Refer also to abstracts 47086, 47087, 47112, 47116, 47152, 47235, 47292, 47306, and 48481.

47201 (BNWL-723) TREATMENT OF WASTE SOLIDIFICATION CONDENSATES. Touhill, C. J.; Mercer, B. W.; Shuckrow, A. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1968. Contract AT(45-1)-1830. 105p. Dep. CFSTI.

During the solidification of highly radioactive wastes, some low and intermediate level condensates are encountered as secondary effluent streams. For complete demonstration of the solidification processes, these condensates must be effectively treated so that any potential for release to the environment is avoided. The research performed in exploring methods for attaining this objective is described. Two types of condensates requiring treatment were identified as glass melter condensate, and nitric acid fractionator condensate. In the first case, 10 potential treatment meth-

ods were investigated with emphasis on those offering the most promise, i.e., scavenging, volatilization, precipitation, distillation, and asphalt incorporation. In general, the methods fit categories designated as separation of sulfates, and conversion to solid forms. In treating acid fractionator condensates, methods such as adsorption, electrodialysis, ion exchange, and oxidation were explored. As a result of this research, alternatives considered to be the most effective for treating these condensates have been selected and described herein. In the case of glass melter condensate full-level radioactive demonstration is planned. (auth)

47202 (BNWL-SA-1447) EXTRACTION STUDIES OF CERIUM(III) INTO DI-(2-ETHYLHEXYL)PHOSPHORIC ACID AND THE OBSERVATION OF ITS OXIDATION IN THE PRESENCE OF CONCENTRATED NITRATE SOLUTIONS TO FORM A Ce(IV)–NITRATE–DEHP COMPLEX. Bray, L. A.; Partridge, J. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 18p. (CONF-680913-1). Dep. CFSTI.

From 5th International Conference on Solvent Extraction Chemistry, Jerusalem, Israel.

Recent studies showed that a yellow Ce(IV) complex was obtained when Ce(III) was extracted by HDEHP and then washed with high nitrate concentrations (6 to 7M) of various inorganic salt solutions [Na(I), Sr(II), Ce(III), or Al(III)], or when Ce(III) was extracted directly from these concentrated nitrate solutions. When Ce(III) was extracted into HDEHP from very dilute nitrate solutions or from solutions containing anions such as Cl^-, SO_4^{2-}, or OH^-, the organic phase remained colorless. Since the oxidation potential of the Ce(III) – Ce(IV) couple is –1.61 volts, this observation of cerium oxidation in the presence of high nitrate solutions and HDEHP appeared worthy of further study. The solvent extraction of cerium with HDEHP and the formation of Ce(IV) as a function of nitrate, HDEHP, metal cation, and hydrogen ion concentration is discussed. The Ce-DEHP compound resulting from the extraction of Ce(III) from high nitrate solutions was prepared and compared with that of Peppard and Ferraro (J. Inorg. Nucl. Chem. 10: 275(1959)) through elemental analysis, ir spectrometry, and vapor pressure osmometry. (P.C.H.)

47203 (NUMEC-1661-2) RECOVERY OF PLUTONIUM FROM ZPPR UNMEASURABLE WASTES. Progress Report, January 27–July 31, 1968. Garber, H. J. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Aug. 28, 1968. Contract AT(1-11)-1661. 31p. Dep. CFSTI.

Work is being carried out to develop a fully engineered design of a treatment facility capable of recovering plutonium values from the unmeasurable wastes generated during the fabrication of ZPPR ternary alloy fuel plates. (M.C.G.)

47204 (ORNL-4254, pp 241-78) MOLTEN-SALT PROCESSING AND PREPARATION. (Oak Ridge National Lab., Tenn.).

Topics covered include: distribution coefficients in molten salt – metal systems, protactinium removal from a single-fluid MSBR, continuous fluorination of molten salt, relative volatility measurements by the transpiration method, distillation of MSRE fuel carrier salt, protactinium removal from a two-fluid MSBR, recovery of uranium from MSRE salt by fluorination, MSRE fuel salt processing, preparation of $^7LiF-^{233}UF_4$ fuel concentrate for the MSRE, and decay heat generation rate in a single-region molten-salt reactor. (M.C.G.)

47205 (ORNL-TM-2290) SOME FACTORS AFFECTING THE CHOICE OF A SOLVENT EXTRACTION CONTACTOR FOR THE 1ST CYCLE REPROCESSING OF LMFBR FUELS. Groenier, W. S. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 23p. Dep. CFSTI.

Three very different types of solvent extraction contactors are being considered for inclusion in the 1st cycle LMFBR fuel reprocessing concept. The pulsed extraction column, the Savannah River Centrifugal Contactor, and the ORNL Stacked-Clone Contactor were compared using a possible LMFBR flowsheet with typical feed and various design and operating information that is available. Contactors were sized for a reprocessing plant having a capacity of 5 metric tons (uranium + plutonium + fission product) per day. Comparisons were made on the basis of approximate solvent radiation dosage. In both the centrifugal contactor and the stacked-clone contactor this was <20% of that in the pulsed column. Additional comparisons must be made on the basis of cost. (auth)

47206 (ORNL-tr-1771) DECONTAMINATION OF RADIOACTIVE WASTES BY MEANS OF ION EXCHANGE. de Lora Soria, F.; Yee, W. C. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from paper presented at 13th Biennial Meeting of the Spanish Society of Physics and Chemistry, Madrid, Spain, June 1967. 16p. (CONF-670652-1). Dep. CFSTI.

A process for decontamination of wastes of low-level radioactivity by coagulation-clarification-adsorption on activated carbon ion exchangers is described. The effluent of the process is decontaminated and demineralized water, which can be reused. The radioisotopes studied were: ^{144}Ce, ^{106}Ru, ^{137}Cs, $^{95}Zr-^{95}Nb$, ^{125}Sb, ^{60}Co, ^{131}I, ^{90}Sr, and total rare earths. The total decontamination factors range from 100 to 10,000. (auth)

47207 CARRIER-FREE SEPARATION OF RHENIUM ISOTOPES FROM A DEUTERON-IRRADIATED TUNGSTEN MATRIX. Klockow, D. (Univ., Freiburg i. B.). J. Radioanal. Chem., 1: 325-9(July 1968). (In German).

A method is described for the carrier-free separation of rhenium isotopes from deuteron-irradiated tungsten. After being irradiated, metallic tungsten is first treated with a mixture of hydrofluoric acid and nitric acid, and the residue is then dissolved in ammonia and hydrogen peroxide. Ammonium nitrate is added to the solution, and the pH is adjusted to 4.5 to 5. The separation is performed on a column of hydrous zirconium dioxide using 2% ammonium nitrate solution; ≥99.9 of the tungsten is retained on the ion exchanger. The solution containing the rhenium isotopes is evaporated to dryness, and the ammonium nitrate removed by heating to about 160°C. (auth)

47208 IMPROVED PROCESS FOR EFFECTING ISOTOPIC EXCHANGE IN A MEDIUM CONTAINING AMMONIA. (to Commissariat a l'Energie Atomique). British Patent 1,125,670. Aug. 28, 1968. Priority date Sept. 24, 1965, France.

A process for the isotopic exchange of H and D consists of contacting D-containing H_2 and liquid NH_3 in the presence of trimethylamine. The trimethylamine is present in the proportion of 5 to 40 vol %, and the process is carried out at a temperature of –40 to –70°C. Potassium amide is also present. (B.L.M.)

47209 ENTHALPY OF DISTRIBUTION AS A MEASURE FOR THE STRENGTH OF THE LEWIS BASE USED AS SOLVENTS FOR EXTRACTION. Kettrup, A.; Specker, H. (Ruhr-Univ., Bochum, Ger. Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund, Ger.). Z. Anal. Chem., 240: 1-5(1968). (In German).

The enthalpy which appears during the extraction of a metal ion with an organic solvent can be determined by calorimetric measurements. Measurements were based on the distribution of bismuth, mercury, zinc, and cadmium from a solution containing lithium iodide and the extraction of iron, zinc, and uranium from a solution containing potassium thiocyanate. Uranyl nitrate was also investigated. The organic phase consisted of various esters of phosphoric and phosphonic acid and tri-n-octylphosphine oxide in isooctane. The calculated enthalpies are in accordance with the extraction behavior of the metal ions observed by analytical methods. (auth)

47210 EXPERIMENTAL INSTALLATION FOR THE ISOTOPIC SEPARATION OF ^{15}N BY ISOTOPIC EXCHANGE BETWEEN NO AND NO_2 AND HNO_3. Axente, D.; Fodor, Tr.; Mercea, V.; Peculea, M. (Institut de Physique Atomique, Cluj). Rev. Roum. Chim., 13: 707-12(June 1968). (In Rumanian).

A laboratory installation is described for the enrichment of nitrogen-15 by the method of isotopic exchange between nitric acid and the nitrogen oxides NO and NO_2 according to the method of Spindel and Taylor (Trans. N. Y. Acad. Sci., Ser. I, 19, 1, p.3 (1965)). (tr-auth)

47211 APPLICATIONS OF PHYSICO-CHEMICAL ANALYTICAL METHODS TO THE AUTOMATIC CONTROL OF IRRADIATED FUELS REPROCESSING. Perez, J. J.; Arbogast, M. Bull. Inform. Sci. Tech. (Paris), No. 128, 31-50(July 1968). (In French).

Physical methods of chemical analysis used in automatic control of the treatment of irradiated fuel are differentiated according to their specificity with regard to the parameter being measured. Taking examples selected as the most characteristic in the working of the industrial units (uranium, acidity, nitrous acid) the problems of automated measurements are discussed in some detail both in respect to the choice of method and of instrumentation. The characteristics of the two principal instrumental systems are compared and their advantages and disadvantages on the industrial and laboratory scales are described in simple terms. (auth)

47212 VITRIFICATION OF HIGH LEVEL WASTES. Bonniaud, R. Bull. Inform. Sci. Tech. (Paris), No. 128, 13-30(July 1968). (In French).

Imperative safety reasons entail vitrification of fission product liquid wastes. Different kinds of glass are used according to the composition of the liquids. Glass blocks, weighing several kilograms and having a specific radioactivity of 2 Ci/ml, were prepared on a laboratory scale. Two industrial scale processes are under study: the first, a continuous process, uses preliminary

calcination in a rotary kiln; the other more advanced design is a semicontinuous method involving vitrification in a metallic pot. A pilot plant using the latter is under construction at Marcoule. (auth)

47213 TREATMENT OF IRRADIATED FUELS BY NON AQUEOUS METHODS. Bourgeois, M. Bull. Inform. Sci. Tech. (Paris), No. 128, 3-11(July 1968). (In French).

These processes are being studied for two kinds of fuels: highly enriched uranium–zirconium or uranium–aluminum alloys, and mixed UO_2–PuO_2 stainless steel-clad oxides. Processing or irradiated alloys will be studied in the ATTILA facility, which is described. Results concerning the first runs with unirradiated charges are given. Recent results concerning HF–O_2 chemical decladding of plutonium-bearing oxide fuels are given. Previous studies concerning the separation of uranium and plutonium hexafluorides by selective reduction of this last compound are outlined. (auth)

47214 STABILITY TRENDS OF 1:1 AND 2:1 DIALKYLMALONATO RARE-EARTH CHELATES. Powell, J. E.; Farrell, J. L.; Neillie, W. F. S.; Russell, R. (Ames Lab., Iowa). J. Inorg. Nucl. Chem., 30: 2223-31(Sept. 1968). (IS-1750).

The step-formation constants of the 1:1 and 2:1 malonato, diethylmalonato, di-n-propylmalonato, and di-n-butylmalonato rare earth and yttrium chelates were determined at ionic strength 0.100 (KNO_3) at 25.0°C by a potentiometric method. The first and second ionization constants of the ligand acids were also measured. The trend of the first formation constants with cationic radius, observed with the lanthanide malonates, was followed in the case of the dialkylsubstituted rare earth malonates. Stability increased with complexity of the substituents, although the dimethylmalonate ligand exhibited less affinity for rare earth cations than malonate itself. The trends manifested by the second constants were less regular. A curious odd-even stability differential was apparent in these systems with the heavier rare earths (Tb–Lu). The differential is apparent in both b_1 and b_2, and the cumulative effect in β_2 values was sufficient to cause reversal of usual ion-exchange elution order in the case of the Yb–Lu and the Dy–Ho pairs when ammonium malonate buffer was the eluant on Dowex 50-X8. (auth) (UK)

47215 SEPARATION OF URANIUM FROM RARE EARTH ELEMENTS ON SULPHONIC CATION EXCHANGE RESIN KU-2. III. Krawczyk-Obojska, Irena (Inst. of Nuclear Research, Warsaw). Chem. Anal. (Warsaw), 13: 551-6(1968). (In Polish).

The so-called fluoride elution method for the separation of trace amounts of rare earth elements (10^{-5} to 10^{-1}%) from uranium was elaborated. The method is based on the different behavior of uranium(VI) and rare earth(III) ions in solutions containing fluorides. The mixture was retained on a sulfonic cation exchange resin, KU-2, and uranium was then selectively eluted with 1N MeF solution (Me = Na, K, NH_4, H). Rare earth elements were desorbed with 5N HCl solution. The use of NaF, NH_4F, and HF yields good results for all the investigated range of Ln contents in uranium. In the case of KF, good results were obtained only when the rare earth content was higher than 1.3×10^{-3}%. (auth)

47216 STUDIES OF THE DISTRIBUTION OF MIXED COMPLEXES BETWEEN DIBUTYLPHOSPHATE (HDBP) AND TRIBUTYLPHOSPHATE (TBP), TRIOCTYLPHOSPHINE OXIDE (TOPO) IN HEXANE AND CARBON TETRACHLORIDE. Liem, Djiet Hay (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 22: 753-72(1968).

The distribution of dibutylphosphate (= HDBP = HA) between 0.10 M H_2SO_4 and hexane or CCl_4 in the presence of tributylphosphate or trioctylphosphine oxide (= B) was studied using ^{32}P-labeled HDBP. Treatment of the distribution data with the LETAGROP VRID computer program indicated the formation of the following species in the organic phase: HA and H_2A_2, and in hexane $(HA)_n$ ($n \geq 4$); with B = TBP, HAB, and H_2A_2B, and in hexane HAB_2, and with B = TOPO, HAB, and in hexane H_2A_2B. At $A_{aq} > 1$ mM the data indicate the formation of HDBP dimers in the aqueous phase. A summary of the equilibrium constants for the formation of the various $(HA)_pB_q$ species is tabulated. (auth)

47217 SYNERGISTIC EFFECT IN THE EXTRACTION OF ^{233}U(VI) BY DIBUTYLPHOSPHATE (HDBP) IN THE PRESENCE OF TRIBUTYLPHOSPHATE (TBP), TRIOCTYLPHOSPHINE OXIDE (TOPO) IN HEXANE AND CARBON TETRACHLORIDE. Liem, Djiet Hay (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 22: 773-90(1968).

The extraction was studied of ^{233}U(VI) from aqueous 0.1 M H_2SO_4 into hexane or carbon tetrachloride by dibutyl phosphate (= HA) in the presence of tributyl phosphate or trioctylphosphine oxide. Computer analysis of the distribution data with the LETAGROPVRID program indicates the formation in the organic phase of the following extractable uranyl species: $UO_2A_2(HA)_2$; with B = TBP, $UO_2A_2(HA)_2B$, $UO_2A_2(HA)B$, and in hexane $UO_2A_2B_2$ and $UO_2SO_4B_2$; with B = TOPO, UO_2A_2B, $UO_2A_2B_2$, UO_2SO_4B, and in CCl_4 and $UO_2A_2(HA)B$. A summary of the equilibrium constants for the formation of the various extractable uranyl species is tabulated. The results indicate that both addition-type uranyl species $[UO_2A_2(HA)_2B]$ and substitution-type species $[UO_2A_2(HA)B, UO_2A_2B_2]$ may contribute to the synergistic effect found in the extraction of U(VI). (auth) (Denmark)

47218 FRENCH PROCESS FOR MAKING HEAVY WATER. Bauche, P.; Lefrancois, B. Ann. Mines, No. 5, 17-30(May 1968). (In French).

The role of heavy water in military and civil nuclear programs is reviewed. Several processes for deuterium separation are discussed: processes based on physical properties, procedures using isotope exchange, particularly the American (H_2S-H_2O process) and the French process (NH_3-H_2) developed at Houilleres du Nord and at Pas-de-Calais in collaboration with the Commissariat a l'Energie Atomique. Problems to be solved in the construction of a plant to produce 20 to 25 tons/year, just put into operation at Mazingarbe (Pas-de-Calais) are outlined. (BBB)

47219 REMOVAL OF TELLURIUM HEXAFLUORIDE FROM GASEOUS SYSTEMS BY SOLID REAGENTS. Vissers, Donald R.; Steindler, Martin J. (Argonne National Lab., Ill.). Ind. Eng. Chem., Process Design Develop., 7: 496-502(Oct. 1968).

Static gas sorption studies were carried out to screen 13 potential reagents as sorbents for TeF_6. The most promising, activated alumina and BPL activated charcoal, were evaluated as sorbents for TeF_6 in factorially designed sets of studies using an isotope dilution technique with ^{125m}Te to evaluate the TeF_6 sorption in a gas flow system. The effects of temperature (25 and 100°C), bed height (1 and 2 in), gas velocity (20 and 40 feet per minute), and tellurium hexafluoride concentration (190 to 500 ppM) on the removal efficiency of tellurium hexafluoride were evaluated; bed height was found to be the most important. Activated alumina and BPL activated charcoal were found to remove TeF_6 effectively (>99.99%) from air–TeF_6 systems (190 to 500 ppM TeF_6). Activated alumina also was an effective sorbent for TeF_6 in the presence of low concentrations of fluorine in air. The heat of sorption for TeF_6 on activated alumina was 5 kcal per mole. (auth)

47220 FIVE YEARS EXPERIENCE OF IRRADIATED FUEL PROCESSING AT THE MARCOULE PILOT PLANT. Niezborala, F. Bull. Inform. Sci. Tech. (Paris), No. 127, 75-89(June 1968). (In French).

During its first five years of operation the pilot plant for irradiated fuel processing has treated irradiated test fuels of natural uranium, molybdenum–uranium of different molybdenum concentrations and fuels with an antidiffusion layer of Aquadag. The behavior of new solvents such as trilaurylamine, and different processes for the recovery of neptunium in solutions from the Marcoule plant, were also studied. Blocks of glass were prepared from concentrated solutions of fission products to study their properties. (auth)

47221 STUDIES ON THE PROCESSING OF FUELS BASED ON ALLOYS CONTAINING HIGHLY ENRICHED URANIUM. Michel, P. Bull. Inform. Sci. Tech. (Paris), No. 127, 61-73(June 1968). (In French).

A survey is presented of the studies undertaken in France for reprocessing of enriched uranium-containing fuels: building of an active pilot plant; many studies about batch and continuous dissolving of uranium–aluminum alloys; and study and perfecting of a new process for uranium–zirconium alloys reprocessing. (auth)

47222 PROCESSING OF IRRADIATED FUELS BASED ON SLIGHTLY ENRICHED URANIUM OXIDE. Lefort, G.; Miquel, P. Bull. Inform. Sci. Tech. (Paris), No. 127, 43-60(June 1968). (In French).

In order to develop a purification procedure applicable to strongly irradiated fuels of the oxide type, the different cycles involved in the process were studied and tested. The practical conditions of these tests, certain of which were conducted at very high activities (~20,000 MWJ t^{-1}), and the main results obtained are given. From these experiments it was possible to specify the decontamination factors that might be attained in an industrial facility in spite of the parasite reactions due to tributyl phosphate degradation products. Very encouraging information was obtained on the purity of the finished products, the losses in fissile material, and the safety margin of the process. (auth)

47223 THE PROCESSING PROBLEM OF IRRADIATED FUELS RELATED TO THE EVOLUTION OF FUEL ELEMENTS. Faugeras, P. Bull. Inform. Sci. Tech. (Paris), No. 127, 9-25 (June 1968). (In French).

The increasing complexity of fuel elements will necessitate modifications to processing plants at Marcoule and the Hague. The strong radiolysis of the solvent is the chief obstacle in the application of the T.B.P. process to fueled enriched uranium or uranium–plutonium oxides. Remedies are being studied, both technological (centrifuge extractor) and chemical (zirconium complexing agent), in an attempt to extend the limits of application of the process. Beyond these limits the use of dry processes is being investigated. The T.B.P. process is applicable to the highly enriched uranium series (uranium–aluminum, uranium–zirconium), but raises problems of fission product solution storage and, in the case of uranium–zirconium, problems of corrosion. The process based on the selective volatilization of halides seems to be suitable for this type of fuel. (auth)

47224 OXIDATION-REDUCTION OF PLUTONIUM IN THE PROCESSING OF IRRADIATED FUELS. Chesne, A. Bull. Inform. Sci. Tech. (Paris), No. 127, 27-33(June 1968). (In French).

Redox properties of plutonium were reviewed in the framework of the reprocessing of spent fuels. Equilibria between Pu(III)–Pu(IV) and PU(IV)–Pu(VI) related to acidity and nitrous acid concentration were considered. The effects of nitric acid radiolysis product on aqueous plutonium chemistry were emphasized. (auth)

47225 CHEMISTRY OF IRRADIATED FUELS. Sauteron, J. Bull. Inform. Sci. Tech. (Paris), No. 127, 3-8(June 1968). (In French).

The activities of the Services de Chimie des Combustibles Irradiés are divided into four parts: studies on treatments using aqueous methods, which are reported in the June, 1968 issue of Bull. Inform. Sci. Tech.; studies on treatments using dry methods and studies on fission products, included in the July, 1968 issue; and, studies on the transuranium elements, reported in the May, 1968 issue. (J.G.B.)

47226 STABILITY OF SOLVENTS IN FUEL REPROCESSING. Bathellier, A. Bull. Inform. Sci. Tech. (Paris), No. 127, 35-41 (June 1968). (In French).

The chemical and radiolytic decomposition of solvents and diluents used industrially is considered. Principal degradation products are listed for both tributyl phosphate and trilaurylamine and their effects on the process chemistry are summarized. Possibilities of removing them from organic solutions are indicated. (auth)

47227 ION SEPARATION. Ahrland, Sten Harald (to Aktiebolaget Atomenergi). British Patent 1,126,825. Sept. 11, 1968. Priority date Feb. 23, 1965, Sweden.

A method is described for the separation of ions of alkali metals and alkaline earth metals from UO_2^{2+}, particularly for the separation of Cs and Sr ions from UO_2^{2+}. The solution containing the ions is contacted with solid particles of zirconium phosphate having a mole ratio of P to Zr of from 1.8 to 2.1 and a water content, removable by calcination, of from 0.8 to 2.0 moles of H_2O/mole Zr; and the alkali and alkaline earth metal ions are preferentially transferred to the zirconium phosphate. (B.L.M.)

47228 PRODUCTION AND RECOVERY OF BERYLLIUM CHLORIDE. Bach, Ricardo Otto (to Beryllium Metals and Chemicals Corp.). British Patent 1,126,712. Sept. 11, 1968. Filed Dec. 3, 1965.

A method is described for the separation of Be as $BeCl_2$ from BeO or a Be ore by the reaction of the oxide directly with Si and Cl_2. The ratio of the weight of Be in the BeO or the Be-containing mineral to Si or Si in an alloy is from 1.2 to 1.6, and the mixture of these two components is reacted with Cl_2 at a temperature of from 800 to 1600°C. (B.L.M.)

47229 METHOD FOR REPROCESSING AN IRRADIATED NUCLEAR FUEL WITH MOLTEN SALT CONTAINING AMMONIUM NITRATE. Kamemoto, Yuichiro (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-8680. Apr. 3, 1968. Filed Sept. 9, 1964.

The method proposed has the advantages of simple operation, high decontamination, etc. Ammonium nitrate or a mixture of NH_4NO_3 and a salt (KCl, LiCl, NaCl, KNO_3, $LiNO_3$, or their mixture) is added to the irradiated nuclear fuel, and the whole is heated to melt the fuel in the molten salt. Then, it is passed through a column containing glass powder and calcium oxalate, to remove part of the fission products. After passage through the column, it is heated at about 440°C. The (remaining) fission products are removed either into the gas phase or in the molten salt, and the nuclear fuel itself emerges as the precipitate. (NSA of Japan)

47230 DECONTAMINATION OF RADIOACTIVE WATERS BY COPRECIPITATION WITH $Ca(MnO_4)_2$ AND ACTIVE EARTHS. Furnica, Gh. (Inst. for Hygiene and Labor Protection, Bucharest). Rom. Med. Rev., 10: No. 2, 6-11(Apr.-June 1966).

Methods and adsorbants for the removal of natural and artificial radionuclides from water were explored using as a test solution water containing the following γ-emitting radionuclides: ^{24}Na, ^{51}Cr, ^{55}Fe, ^{59}Fe, and ^{131}I. The use of $Ca(MnO_4)_2$ as decontaminating agent in an alkaline medium permitted decontamination, with an efficiency of 92 to 99%, of waters containing alkaline earth ions, heavy metal ions and anions, precipitating the latter. The presence of alkaline ions and of anions that did not precipitate the ions mentioned did not permit high efficiency decontamination of the isotopes studied. Bentonites from the Baia Mare region of Romania activated with acids were efficient in the decontamination of radioactive alkaline earth ions and less efficient in the decontamination of alkaline ions. Calcination of bentonites lowered their decontamination capacity. (BBB)

47231 METHOD OF SEPARATING BERKELIUM FROM CERIUM. Moore, Fletcher L. (to United States Atomic Energy Commission). U. S. Patent 3,402,027. Sept. 17, 1968.

A method of separating Bk values from an aqueous solution containing Bk together with Ce comprises making solution 5 to 9 M in HNo_3, oxidizing Bk and Ce to the 4+ oxidation state, and passing the resulting solution through an anion exchange column. The Ce is sorbed while the Bk passes through. (AEC)

47232 ISOTOPIC FRACTIONATION OF CARBON IN GEOLOGICAL PROCESSES. Vinogradov, A. P.; Kropotava, O. I. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Int. Geol. Rev., 10: 496-506(May 1968).

Stability of the isotopic composition ($^{12}C/^{13}C$) of carbon in endogenic terrestrial substances, as well as in meteorites, consistently lower in ^{13}C than the biogenic marine carbonates, suggested both the presence and stability of a certain zone under the crust of the earth in which the C systems are maintained at certain equilibria, at different levels, typical of certain geological processes operative therein. Isotopic exchanges and recurrent fractionations of the C isotopes, in the course of the migrations of carbon, were indicated by the available evidence, the net result of which is an impoverishment of ^{13}C in living substance and in its derivatives (oils, coals, etc.), and its enrichment in the biogenic residual carbonates. Tissues of plants and animals are light weight isotopically, on the whole, with −2 to −2.5‰ $\delta^{13}C$. Such carbon accumulates in their tissues because of the fractionation of carbon in the atmospheric CO_2 absorbed by the plants during photosynthesis. The isotopic composition of carbon in the atmospheric CO_2 is −0.7 $\delta^{13}C$‰, but is −2.5 $\delta^{13}C$‰ in the plants, i.e., 1.8‰ lighter. (BBB)

47233 CHEMICAL SEPARATIONS USING α-HYDROXY-ISOBUTYRIC ACID SOLUTIONS AND BOTH CATION AND ANION EXCHANGE RESIN. Perdue, Hazel D.; Conover, Alice; Sawley, Nancy; Anderson, Ruth (Univ. of California, Livermore). Anal. Chem., 40: 1773-6(Oct. 1968).

Rapid chemical separations of some cationic species were achieved in tracer studies with α-hydroxyisobutyric acid solutions adjusted to pH 5 on 9-cm columns of Dowex-50-X8, 100 to 200 mesh ion exchange resin. Column capacity permitted use of 10 to 20 mg of a single carrier. Elution sequence is included for Y, Zr, Th, the rare earths, Fe, Pu, Am, Pb, Ca, Sr, and Ba (separated from Ra). Zirconium was found to elute rapidly in α-hydroxyisobutyric acid solutions (pH 1.8), giving quantitative separations from rare earth and actinide elements that do not elute under these conditions. The procedure also separates from ^{95}Nb–^{97}Nb daughters. (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 47256, 47257, and 47498.

47234 (HASL-195) THE RADIATION FIELD IN AIR DUE TO DISTRIBUTED GAMMA-RAY SOURCES IN THE GROUND. Beck, H.; de Planque, G. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). May 1968. 59p. Dep. CFSTI.

A much more complete and detailed picture of the external environmental γ-ray radiation field has been obtained through γ-ray transport calculations of exposure rates, differential energy spectra, integral exposure rate spectra, and angular exposure rate distributions due to sources distributed on or in the soil half space. The radiation field is examined not only for the natural emitters ^{40}K, ^{238}U, and ^{232}Th but also for γ-rays whose energies are typical of weapons test fallout. The energy spectra and exposure rate angular distributions are shown to vary with detector height and source distribution with resulting important implications in regard to detector calibration and prediction of ground level exposure rates from aerial survey data. Exposure rate results as a function of detector height in air above the soil-air interface are tabulated for various source energies and source distributions. Although the calculated results are for specific soil and air densities, soil moisture and composition, the data can easily be adapted to other soil and air conditions. (auth)

47235 DISPOSAL OF CHEMICAL AND RADIOACTIVE WASTE. PART TWO. Pearsall, S. G.; Wilshusen, W. (Brookhaven National Lab., Upton, N. Y.). J. Chem. Educ., 45: A677-8; A683-4; A686(Sept. 1968).

Methods of waste disposal are reviewed, with emphasis on dilution and storage until it has decayed to a sufficiently low level for release. (M.C.G.)

47236 ON THE TEMPERATURE IN THE EARTH'S UPPER MANTLE MODEL WITH THE RADIOACTIVITY OF CHONDRITIC METEORITES. Maj, S. (Univ., Warsaw). Acta Geophys. Pol., 15: 159-70(1967). (In Polish).

The case of stationary heat flow in a certain model of the Earth's upper mantle with the chondritic meteorites radioactivity is considered. This model is based on the Gutenberg-Bullen's lithosphere model in the region of 100 to 1000 km. In the calculations only empirical data are used. The effective conductivity and temperature gradient distributions as well as the temperature distribution in this model of the Earth's upper mantle are estimated. The calculation method is based on the relationship of the heat flow density to temperature gradient. In this case assumptions relating to the forms of energy transfer in the Earth's mantle are not necessary. The temperature used for estimating the effective thermal conductivity variation in this model was also deduced from theoretical relations. The two results agree. (NSA of Poland)

47237 AN INVESTIGATION OF THE SOURCE OF AIR Ar CONTAMINATION IN K-Ar DATING. Mussett, Alan E. (Liverpool Univ.); Dalrymple, G. Brent. Earth Planet. Sci. Lett., 4: 422-6(Aug. 1968).

Precision of young K-Ar ages is limited by air argon contamination. A series of experiments in which the exposure of basalt and sanidine samples to air argon was controlled, shows that most of the air contamination does not arise in the laboratory. Because of this, it seems unlikely that air argon contamination can be significantly reduced by special sample handling and preparation techniques. (auth)

Meteorology

Refer also to abstracts 47235 and 47431.

47238 (COO-1199-15) TRACING TROPOSPHERIC RADIOACTIVE DEBRIS BY ISENTROPIC TRAJECTORIES. Research Report 3. Wilson, John W.; Jones III, Parker T. (Illinois State Water Survey, Urbana). July 1968. Contract AT(11-1)-1199. 36p. Dep. CFSTI.

Occasionally, large amounts of stratospheric radioactive debris are measured in surface rainwater. Two such situations have been subjected to isentropic trajectory analysis to determine if stratospheric air entered the troposphere as early as 36 hours prior to rainout of the radioactivity. Results of both cases indicated essentially no vertical mixing of upper- or mid-tropospheric air at any time within the period considered. A comparison between machine-computed and hand-produced trajectories was performed. It showed that the machine-produced trajectories were more accurate than either of two hand analysis methods. (auth)

47239 (COO-1407-20) RAIN SCAVENGING STUDIES. Progress Report No. 4. Dingle, A. Nelson (Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography). Aug. 1968. Contract AT(11-1)-1407. 85p. Dep. CFSTI.

The scavenging of contaminants from the air by rain was studied with a view toward defining the physical processes that are most effective in cleaning the air of contamination. Three principle experiments were performed: the first used indium as a tracer to determine whether it is feasible to use tracer techniques in the study of circulation and rain scavenging processes. Indium was found to be useful for this purpose. A second series of experiments demonstrated the feasibility of using indium as a particulate tracer for cloud processes. Neutron activation was used for tracer detection. Finally, the artificial beta radioactivity in rainwater was measured along with rainfall rate to determine the physical processes which affect convective rains. (L.C.L.)

47240 (NYO-3685-14) ON THE MEAN PATH OF BUOYANT BENT-OVER PLUMES UNDER VARIOUS ATMOSPHERIC STABILITY CONDITIONS. Research Report No. 13. Slawson, P. R. (Waterloo Univ. (Ontario). Dept. of Mechanical Engineering). Aug. 1968. Contract AT(30-1)-3685. 92p. Dep. CFSTI.

Careful photographic observations were made on the rise of smoke plumes from the Lakeview Generating Station, Ontario, in the spring of 1965 and 1967. Data relating to the stack variables were collected in some detail. Observations indicate that the dynamical problem of plume rise is very complex. This complexity is especially illustrated in the "wavy" appearance of plumes observed at the Lakeview Generating Station in unstable atmospheric conditions. The relatively simple theory presented correctly predicts (at least qualitatively) the complex observed plume paths and in so doing emphasizes the important physical factors required to adequately describe this path. It was found that the plume's own physical size and the atmospheric turbulence level had a more direct effect on plume behavior than the observed atmospheric temperature gradients, at least for distances from the source of a few thousand feet. In some cases where the plume bends over sharply very near the source the effect of the initial size and momentum of the plume may be important. (auth)

47241 (UCRL-13358) LIDAR OBSERVATIONS OF THE EXHAUST PLUME OF A NUCLEAR-POWERED ROCKET ENGINE. Final Report. Oblanas, John (Stanford Research Inst., Menlo Park, Calif.). Aug. 1968. Contracts AT(04-3)-115; W-7405-eng-48. 39p. Dep. CFSTI.

For Univ. of California, Lawrence Radiation Lab., Livermore.

Lidar (laser radar) observations of the particulate matter within the exhaust plume of a nuclear-powered rocket engine are described. The observations were made by a ruby lidar 5.5 km from the NRX-A6 engine operating at full power in a static test mount on December 15, 1967, at the Nuclear Rocket Development Station, Nevada. The observational data were analyzed to obtain volume backscatter coefficient of the exhaust plume as a function of time, values of volume backscatter coefficient of the plume and the attenuation through the plume, and relative density variations of the particulate matter within the plume. These analyses are presented and discussed. It is concluded that the experiment has demonstrated the feasibility of lidar for the remote, real-time monitoring of the particulate matter within a nuclear-rocket exhaust plume. (auth)

47242 (UCRL-13360) LIDAR OBSERVATIONS OF DEBRIS CLOUDS FROM NUCLEAR CRATERING DETONATIONS. Final Report. Collis, Ronald T. H.; Oblanas, John W. (Stanford Research Inst., Menlo Park, Calif.). Aug. 1968. Contracts AT-(04-3)-115; W-7405-eng-48. 78p. Dep. CFSTI.

For Univ. of California, Lawrence Radiation Lab., Livermore.

Lidar (laser radar) observations of the debris clouds resulting from nuclear cratering detonations are described. Observations were made of the Cabriolet and Buggy events at the Nevada Test Site, Nevada, on 26 January and 12 March 1968, respectively. The lidar data were analyzed to obtain data regarding cloud position, dimensions, and reflectivity for various times after detonation. The results are presented, the application of lidar to the monitoring of nuclear detonation clouds is discussed, possible future approaches are recommended. (auth)

47243 SOME OF THE MEASUREMENTS RESULTS OF NATURAL ATMOSPHERIC RADIOACTIVITY BY MEANS OF RECORDER WITH THE CONTINUOUSLY MOVING FILTER.

Matulyavichyus, V. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B, 52: 201-8(1968). (In Russian).

Data on the variation of the concentration of the natural atmospheric radioactivity in the Vilnius area obtained during June 21 to July 21, 1962, are presented. The regularity of the daily amount of radioactivity was observed with the development of intramassic processes. The individual measurements of the temporal variations of atmospheric radioactivity taken every half hour (and less frequently) did not reflect the variation completely because the concentration of radioactive substances in the ground-level atmosphere changes six or more times in several minutes. (auth)

47244 SIMULATION OF RADIOACTIVE FALLOUT PARTICLES. Izrael, Yu. A.; Ter-Saakov, A. A.; Shchetinin, N. N. At. Energ. (USSR), 24: 584-6(June 1968). (In Russian).

Radioactive fallout particles from nuclear explosions are formed as a result of melting of captured particles of earth or in the upper atmosphere by condensation and coagulation of evaporated explosive substances. An attempt was made to simulate spherical particles and the conditions of their formation. Radioactive particles simulating those produced by above ground explosions over ground with a silicate haze were obtained and analyzed. Radioactive particles produced in voltaic arcs, carbon resistance ovens, air blast carbon furnaces, carbon-graphite resistance furnaces, and high-temperature plasmas had identical appearance and structure. It was shown that the specific surface concentration of isotopes in a selected group of copper-carrier particles of 150 to 1600 μ (64 particles with ^{76}As and 339 particles with ^{35}S) was not dependent on the size of particles (mean square deflection from mean value was 18%). This confirmed the previous postulation on the constant specific concentration of volatile isotopes in particles of various sizes. (R.V.J.)

47245 MICACEOUS-MOLYBDATE TYPE OF OXIDATION ZONE. Fedorov, O. V. At. Energ. (USSR), 24: 582-4(June 1968). (In Russian).

Specific conditions of formation and deposition of uranium molybdate ores were investigated. The ore deposits and anomalies are distributed mostly in large broken zones and are formed in four stages of mineralization (quartz-sericite, pyritic, molybdenite-pitch, and quartz-carbonate). Depending on the primary ore content and morphology, certain differences were observed in their zones of oxidation. In strongly broken zones primary uranium-molybdenum ores are displaced by uranium molybdenum black (up to 150 m in depth) at the 20 m level uranium molybdates are present along with uranium-molybdenum black and ilsemannite. A table showing the vertical zonal distribution of secondary U and Mo minerals is included. (R.V.J.)

47246 VARIATIONS OF ARTIFICIAL RADIOACTIVITY IN THE SURFACE AIR LAYER. Manolov, Liudmil; Teneva, Marinka. Izv. Inst. Khidrol. Meteorol. Bulg. Akad. Nauk, 10: 107-25(1967).

The effects of certain meteorological factors on artificial long-lived radioactivity of the air close to the earth's surface (ACES) were studied. The following results were obtained on the basis of the statistical material studied. The concentration of artificial radioactive products in ACES is influenced to a considerable extent by the various types of frontal disturbances. The dynamics of a passing front and the type and amount of precipitation in it are some of the essential causes for the diurnal variations of the radioactivity of fission products in ACES. In periods of considerable pollution, the dynamics of the fronts has a more marked effect on the pollution variations in ACES than in pure periods. Precipitation has a deactivating effect on ACES. With the increase in the amount of diurnal precipitation, artificial radioactivity of ACES goes down. Correlation between the washing action of the precipitation and its intensity is of a more complex type. Seasonal variations of the artificial radioactivity of the surface air layers depend on the general circulation of the atmosphere. The maxima of pollution of the surface air with fission products depend on the increased exchange of air masses between the stratosphere and the troposphere. A tendency is observed in the latitude sector under survey; with an increase in the geographic latitude of the stations reviewed, the pollution of the surface air decreases. (Meteorol. Geoastrophys. Abstr.)

47247 USE OF RADON MEASUREMENTS TO IDENTIFY AIR MASSES OVER THE INDIAN SEAS DURING THE SOUTHWEST MONSOON SEASON. Desai, B. N. Indian J. Meteorol. Geophys., 18: 403-4(July 1967).

Air rich in Rn over the Arabian Sea both during and between active monsoons would only show that Rn results cannot be utilized for interpreting air mass movements. Westerly air over the Arabian Sea need not always be from Arabia and northeast Africa. If the deflected Trade Winds are not present in the lower levels, the air from Arabia being warm, an inversion will develop from the surface as soon as the air begins to travel over colder sea. Ordinarily there will not be air from Arabia in the low levels over the Arabian Sea during the months of June to September when the monsoon season is active or strong as judged from rainfall on the west coast. Measurements of Rn cannot be used to identify air masses during the southwest monsoon season. Large Rn values over the Arabian Sea both during break and active monsoon conditions would indicate that Rn might be escaping into air from the sea floor. The causes of the Rn values suddenly changing near about 5°N, being very high to the north and low to the south, are not clear. Information regarding the chemistry of the sea floor might throw light on this point. (BBB)

47248 COMPARATIVE STUDY OF GROUND-PRESSURE WAVES IN VARIOUS ATMOSPHERIC MODELS. MacKinnon, Robert F. (Imperial Coll. of Science and Tech., London). Can. J. Phys., 46: 1731-44(Aug. 15, 1968).

Dispersion curves and stationary phase contributions to theoretical ground-pressure waves from low-altitude nuclear explosions are presented for model atmospheres containing winds. Comparison is made with previously published results. It is shown that the reflection of waves above an altitude of 120 km can result in certain effects in waves with periods greater than 5 minutes. These effects are readily observable in microbarographic records associated with nuclear explosions. It is shown that winds can have a pronounced effect on wave characteristics at periods between 1 and 10 minutes. It is concluded that the effects of low-atmospheric winds are best observed in the behavior of waves of periods less than 4 minutes. Details are given of the numerical procedures followed in obtaining results. (auth)

Mineralogy and Exploration

47249 (AERE-R-5500(Vol.2), pp 387-98) EXTRACTION OF URANIUM AND OTHER INORGANIC MATERIALS FROM SEA WATER. Keen, N. J.; Miles, J. H.; Spence, R. (Atomic Energy Research Establishment, Harwell (England)).

The commercial success of plants for the extraction of magnesium hydroxide and bromine from sea water suggests that others of the more plentiful constituents could be separated if prices were favorable. It seems unlikely however, that this will happen so long as present prices prevail. The same is true of elements present at low concentration although special considerations apply in the case of uranium. Progress has been made towards a process based on absorption on hydrous titanium oxide with the aim of establishing a reserve of medium cost uranium. If a plant using this process became operative it might be possible to extract certain other useful trace elements at the same time. (auth)

47250 HISTORICAL ASPECTS OF THE GEOCHEMISTRY OF MULTIVALENT ELEMENTS IN DEPOSIT FORMATION. Kaemmel, Thomas A. S. (Humboldt-Univ., Berlin). Wiss. Z. Humboldt-Univ. Berlin, Math.-Naturwiss. Reihe, 16: 795-800 (1967). (In German).

Changes of the Eh values and pH values of natural waters on the Earth's surface determine some of the historical aspects of the formation of deposits. A change in valence of multivalent elements is associated with a sudden change in solubility; hence the time of exogenous occurrence of elements like U, Fe, and Cu is sharply defined. The historical nature of some types of U deposits can be explained paragenetically. Most U comes from Witwatersrand-type deposits, which are Precambrian; their uraninite is detritus, and they are present as fossils and sometimes metamorphic soaps. These observations are not fully accounted for. Presumably the detritic nature of pitchblende and sulfides plays a role in explanation. Younger deposits include the U red beds, where U has been chemically precipitated. Formation of uraninite during disintegration gives very low Eh values or low values with no CO_2. Chemical precipitation in the red bed type is due to lowering of the Eh of the U(VI) containing water by organic material. Inverted, this notes that primary uraninite can be dissolved with the formation of U(VI) and complexes. The Witwatersrand type is Precambrian, the second must be post-Precambrian. A mixture is forbidden; both types are historically bounded. (BBB)

47251 URANIUM CHALLENGE. Mining J. (London), 269: 433-4(Dec. 8, 1967).

The U mining situation throughout the world is reviewed in relation to present requirements and trends in installation of nuclear power plants. Principal sources and exploration in North America, Canada, and South Africa, present outputs, and estimated reserves are considered in detail. Assuming an installed capacity in the Free World of about 300,000 MW by 1980, the mining industry can satisfy demand though much depends on U price. An increase

of $1 per lb U_3O_8 would result in a rise of 0.08 mills/kWh, probably less significant than rises in fuel and labor costs in conventional plants. (UK)

Oceanography

Refer also to abstracts 47235, 47249, 47258, 47262, 47287, 47288, and 48715.

47252 (AERE-R-5500(Vol.1)) PROCEEDINGS OF THE CONFERENCE ON THE TECHNOLOGY OF THE SEA AND THE SEA-BED HELD AT THE ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, APRIL 5TH–7TH, 1967. (Atomic Energy Research Establishment, Harwell (England)). 1967. 272p. (CONF-670450–(Vol.1)). Dep. CFSTI. UK 30s. 0d.

Volume I of the Conference on the Technology of the Sea and Sea-bed includes ten papers on fisheries, underwater viewing techniques, and underwater handling and construction. (L.C.L.)

47253 (AERE-R-5500(Vol.2)) PROCEEDINGS OF THE CONFERENCE ON THE TECHNOLOGY OF THE SEA AND THE SEA-BED HELD AT THE ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, APRIL 5TH–7TH, 1967. (Atomic Energy Research Establishment, Harwell (England)). 1967. 240p. (CONF-670450–(Vol.2)). Dep. CFSTI. UK 30s. 0d.

Sixteen papers from the conference on the technology of the sea and the sea-bed held at Harwell, England, April 5 to 7, 1967 are presented. Separate abstracts were prepared for four. The remaining 12 papers contain information on geology of the sea, mineral and hydrocarbon content of sea and sea-bed, and sea rigs, platforms, and power sources not within scope of NSA. (L.C.L.)

For abstracts of individual papers see: 47249, 47258, 47287, and 48715.

47254 (AERE-R-5500(Vol.3)) PROCEEDINGS OF THE CONFERENCE ON THE TECHNOLOGY OF THE SEA AND THE SEA-BED HELD AT THE ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, APRIL 5TH–7TH, 1967. (Atomic Energy Research Establishment, Harwell (England)). 1967. 281p. (CONF-670450–(Vol.3)). Dep. CFSTI. UK 30s. 0d.

Eighteen papers from the conference on the technology of the sea and sea-bed, held at Harwell, England, April 5 to 7, 1967 are presented. A separate abstract was prepared for one paper. The remaining 17 papers contain information on sea-bed movement and control and meteorological and oceanological technology not within scope of NSA. (L.C.L.)

For an abstract of the individual paper see: 47288.

47255 COBALT, SILVER, AND URANIUM CONCENTRATIONS OF REEF-BUILDING CORALS IN THE PACIFIC OCEAN. Veeh, H. Herbert; Turekian, Karl K. (Yale Univ., New Haven). Contract AT(30-1)-2912. Limnol. Oceanogr., 13: 304-8(Apr. 1968). (YALE-2912-15).

A study was made of the concentration of silver, cobalt, and uranium in the calcium carbonate skeletons of reef-building corals, using neutron activation analysis. The silver, cobalt, and uranium concentrations in the corals vary considerably, with mean values of 0.041 ppM Ag, 0.005 ppM Co, and 2.2 ppM U. The Ag:Ca and Co:Ca ratios in the corals are much lower than those reported for open ocean water from the same general area, showing that corals discriminate against these trace elements during the deposition of their aragonite skeletons. The U:Ca ratios in the corals on the average appear to approach that of seawater with a slight discrimination against uranium. Variations among species from the same locale, beyond the limits of analytical error, further suggest biochemical control by the corals in the incorporation of uranium in the skeleton. (auth)

Seismology

Refer also to abstract 47260.

47256 (UCID-5034) THE DYNAMIC EQUATION OF STATE OF ROCKS. A Summary of Ester Data. Kusubov, Andre (California Univ., Livermore. Lawrence Radiation Lab.). Aug. 18, 1964. 41p. Dep. CFSTI.

A summary of ester data of the Hugoniot equation of state of rocks is presented. This summary includes the dynamic properties of specific rocks and supplementary data on the physical properties of each rock. Plots of shock velocity (U_s) versus particle velocity (U_p) are given for each material. (L.C.L.)

47257 (UCRL-13357) EQUATION OF STATE OF ROCKS. Petersen, Carl F.; Murri, William J.; Anderson, G. D.; Allen, C. F. (Stanford Research Inst., Menlo Park, Calif.). June 15, 1968. Contracts AT(04-3)-115; W-7405-eng-48. 88p. Dep. CFSTI.

For Univ. of California, Lawrence Radiation Lab., Livermore.

Hugoniot and release adiabat curves were measured for Hardhat granodiorite for stress levels between 100 and 600 kbar using streak camera techniques. An elastic precursor of amplitudes of 40 to 50 kbar is present for stress levels below about 300 kbar. No clear dependence of the Hugoniot elastic limit on specimen thickness was observed for specimen thicknesses between 6 and 26 mm, but the double wave profile is much more clearly defined in the thicker specimens. The release adiabat curves are initially steep, indicating that the phase transformation that occurs under shock is not completely reversible. Most of the Hugoniot and release adiabat measurements for Scroll tuff were made using reconstituted specimens because the natural material is coarse-grained and inhomogeneous. At 100 kbar the initially very porous tuff is compressed to the same specific volume as the nonporous Hardhat granodiorite. The tuff release adiabat curves are not as steep as those for granodiorite. The final volume reached by the tuff on release, while greater than the corresponding volume reached by granodiorite, is significantly less than the original specific volume. Several low stress experiments were conducted to determine the Hugoniot elastic limit for Pictured Cliffs (Gasbuggy) sandstone. No clear precursor was seen for peak stresses between 5 and 14 kbar. Hugoniot and release adiabat measurements were made on single-crystal sodium chloride samples shocked in the [100] and [111] directions and on rock salt specimens from the Tatum salt dome. The elastic precursor amplitudes and propagation velocities were measured for the above samples as well as for the [110] direction in single-crystal sodium chloride. Stress relaxation effects were observed in both the single-crystal sodium chloride and the Tatum rock salt. An approximate theoretical description of the shape of the stress-time profile following the elastic precursor was developed for the [100] direction in single-crystal sodium chloride. Preliminary experiments for development of a particle velocity gage were performed. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 47242, 47248, 47305, 47352, and 47412.

47258 (AERE-R-5500(Vol.2), pp 371-86) USE OF NUCLEAR EXPLOSIVES FOR SEA BED MINING. Tomblin, J. T. (and others) (Atomic Weapons Research Establishment, Aldermaston (England)).

The existing Partial Test Ban Treaty prohibits the use of nuclear explosives underwater. However, it has been proposed at Geneva that provision be made in future treaties to permit the use of nuclear explosives for peaceful purposes conducted under international supervision. Assuming therefore that it may one day be politically permissible to use this tool for winning mineral deposits within the sea bed, a review is made of the manner in which it might be used and of the hazards to public safety. Two classes of application are considered: cratering explosions and fully contained explosions. Dry-land data for both have been taken from U.S.A.E.C. Plowshare reports and transposed to a sea bed envoronment. It is suggested that, for the cratering application, there are substantial safety problems which are unlikely to be resolved for many years. In the contained application these are reduced to the effects of seismic shock for which an adequate safety margin can be defined. Several projects are described which are being investigated jointly by A.E.C. and industry to exploit this application. It is for consideration whether they can be economically applied to the sea bed. (auth)

47259 (SC-DC-2342) SHOCK PROPAGATION AT LARGE DISTANCES. Reed, Jack W. (Sandia Corp., Albuquerque, N. Mex.). [nd]. 9p. (CONF-610603-1). Dep. CFSTI.

From Symposium on Atmospheric Acoustic Propagation, El Paso, Tex.

An assumption is usually made that weak shock waves (overpressure < 1 psi) are propagated adiabatically and acoustically. In a homogeneous atmosphere this gives overpressure inversely proportional to distance from an explosion and inversely proportional to the square root of distance from a supersonic projectile. An opposing theory was proposed by DuMond et al., in 1946 to show that entropy changes in a shock front would cause explosive overpressures to decay faster with distance and projectile bow waves to decay like $(\text{distance})^{-\frac{1}{2}}$. A few bits of experimental evidence show that neither scheme is exactly correct. Measurements at low overpressures over large distances free of refractive effects are necessary to more accurately resolve the propagation decay laws. This requires vertical shock paths through a real atmosphere. Project Banshee tests will allow measurements where blast pressure differences between different predictions are more than a factor of ten. High altitude atomic tests have only given a factor of two difference, so instrument errors may have obscured correct interpretation. Some preliminary small charge experiments have just been completed where the difference was a factor of four. (auth)

47260 STERLING EXPERIMENT: DECOUPLING OF SEISMIC WAVES BY A SHOT-GENERATED CAVITY. Springer, D. (Univ. of California, Livermore); Denny, M.; Healy, J.; Mickey, W. J. Geophys. Res., 73: 5995-6011(Sept. 15, 1968).

The Sterling experiment was detonated at 380 tons of nuclear yield in the Salmon shot-generated cavity on December 3, 1966, at 0615 CST. Sterling data from several seismic stations that had previously recorded Salmon signals are interpreted to give values of the decoupling of seismic waves. In particular, the decoupling is deduced as a function of frequency for shot-generated cavities operated at the yield level for Sterling (380 tons) and the yield level for Salmon (5.3 kT). Because it was not possible to deduce decoupling from two shots of the same yield, decoupling ratios were inferred on the basis of a first-power scaling law of amplitude versus yield. A value of 70 ± 20 is seen for the two yield levels at 1 to 2 cps, but this value reduces in different oscillatory ways to 40 or less above 15 cps. A similar function for 5.3 kT in a mined cavity is derived, which shows decoupling values of about 120 at 1 to 3 cps and values less than 10 above 15 cps. The deduced body-wave magnitude (m_b) for Sterling is 1.35. (auth)

47261 UNDERSTANDING AND CONSTRUCTIVELY USING THE EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS. Rodean, Howard C. (Univ. of California, Livermore). Rev. Geophys., 6: 401-45(Aug. 1968).

Research is directed toward the understanding of underground nuclear explosion phenomena and applied to developing constructive applications for nuclear explosions. The equations of state for geological materials are of fundamental importance in describing the response of these materials to nuclear explosions. These equations are based on geophysical and laboratory measurements of chemical and physical properties and on theoretical calculations for the high-pressure and high-temperature conditions not accessible to measurement. Physical measurements of ground motion generated by explosions are used, together with the equations of state, chemical and thermodynamic theory, and the laws of continuum mechanics, to develop mathematical models for predicting explosion phenomena. Postshot exploration is used to determine the residual explosion effects, such as heat deposition, rock fracturing, and chimney formation. These explorations give physical and chemical clues that aid in the interpretation of the experiment. Safety considerations include airblast and seismic motion that may damage property and radioactivity that may be a health hazard. Progress has been made in predicting airblast, ground motion, and radioactivity distribution. Nuclear explosions are intense sources of neutrons; therefore, experiments are conducted to measure neutron cross sections and to produce heavy elements. The heaviest nuclide produced to date by this technique has a mass number of 257. The seismic waves generated by nuclear explosions have been used by geophysicists to determine the internal structure of the earth with a precision not possible with earthquakes. (auth)

47262 PROPERTIES OF RADIOACTIVE DAMAGE AT SEA. Piotrowski, Wienczyslaw. Przegl. Morski, No. 9, 3-10(1967). (In Polish).

Radioactive damage is often exaggerated or underestimated. The problem of radioactive damage from nuclear explosions on land and sea and the effect of this damage on the operation of ships and ports are examined. The subjects covered are nuclear explosions at sea (on the surface of the water and underwater), damage from explosions on the surface of the ground, comparison of radioactive damage on land and sea, effects of this damage on ships and ports, and other general considerations. Tabulated data on damage effects are presented. (JPRS)

Facilities and Equipment

Refer also to abstracts 47284, 47301, 47307, 47672, 47871, 47872, 48038, and 48065–48069.

47263 (AECL-2713) HEAT TRANSPORT PUMPS. Renshaw, R. H. (Atomic Energy of Canada Ltd., Sheridan Park (Ontario)). July 1968. 23p. Dep.

The coolant, usually water, is circulated through the core of a nuclear reactor by pumps which operate at high temperature and pressure. They operate in areas not accessible during plant operation. Power plant reliability depends on continuous operation of this heat transport system. Most pumps for this purpose are vertical single-stage, single suction, electrically driven designs. This type is chosen for compactness and symmetry and because it has only one shaft seal. Its disadvantage is that the rotating assembly presents a complex bearing problem which is described. The shaft seal is critical. Several well developed designs for this service are believed reliable and should have a seal life of 25,000 hours. Leakage, which is collected, should not be more than a few gallons per minute. Size, availability and manufacturing problems are discussed. Experience with pumps in service to date with an examination of probable causes of failure is considered in some detail as well as future projections for large pumps up to 7200 hp. (auth)

47264 (CEA-R-3373) HEATING OF LEADS CASKS. AN ANALYTICAL SOLUTION TO THE HEAT EQUATION MADE UP OF A SERIES OF LAGUERRE FUNCTIONS. Formery, Philippe; Gilles, Andre (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar. 1968. 28p. (In French). Dep.

The packing used for the transport of highly radioactive materials such as in-pile irradiated rods must comply with fairly strict safety standards. They should be particularly resistant to fire without the radioactive protection being seriously affected. The heating of a transport cask placed in a fire has been calculated by normal automatic computation methods assuming that only thermal radiation is responsible for the heating and that this obeys Stefan's law. Simultaneously, a purely analytical treatment has been attempted. The existence of a simple solution, of the Laguerre function type, to the heat equation has been demonstrated. By superimposing an infinite number of simple solutions, it is possible to produce a fairly general solution, depending on parameters, which satisfies the initial state and the limiting

conditions. The parameters can be adjusted so that the temperature and flux produced on the shell by this solution approximately satisfy Stefan's relationship. (auth)

47265 (GEPP-40) EXTERNAL ELECTRON BEAM IMPULSE HEATING. Kovacs, S. G. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). July 15, 1968. Contract AT(29-2)-656. 24p. (R-68-ND-17). Dep. CFSTI.

The performance capability of an electron beam gun when used as an external, high-intensity impulse heating source for controlled flash evaporation of rare earth getter materials such as holmium, samarium, and thulium is discussed. The film substrate used in this investigation was molybdenum; evaporation temperatures were in the 830° to 1030°C range for time intervals from 2 to 30 seconds. The performance capability is given in terms of electron beam equivalent temperature parameters for: repeatability on day-to-day basis; resolution; control accuracy; and eight-hour operation stability. The electron beam gun is capable of providing temperature increase rates ranging from 100° to 3000°C per second. (auth)

47266 (NAA-SR-Memo-11753) SCTI EVALUATION STUDY. Holz, H.; Casey, D. (ed.) (Atomics International, Canoga Park, Calif.). Dec. 27, 1965. 197p. Dep. CFSTI.

An evaluation study was conducted which had two primary objectives, the first of which was to review the design of the Sodium Components Test Installation (SCTI) and determine if it was adequate to support the tests of the ALCO steam generator and to identify future changes necessary to accommodate testing of the steam generators. The second objective was to determine the plant availability and its adequacy to support the testing program. The acceptable availability criteria were based on a standard for plant outage not in excess of five days and not more than two outages per month. The major components in the SCTI were reviewed relative to their design specifications and operating conditions at 100% load. These data and the various system diagrams are presented. System modifications that will be required for testing the steam generators are discussed. The proposed system modification is shown. Process deviations from normal operations, their allowable variation or set point and corrective action are discussed and tabulated. Plant protective system action preventing gross plant damage due to process deviations and component malfunctions is graphically displayed. The plant availability prediction and component evaluation, failure mode and risks are discussed. Service requirements for maintenance and suggested spare parts are also discussed. (R.C.K.)

47267 (UCRL-71150) CRYOGENIC ELECTRICAL LEADS. Henning, Carl D. (California Univ., Livermore. Lawrence Radiation Lab.). July 12, 1968. Contract W-7405-eng-48. 13p. (CONF-680621-3). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

Electrical leads entering a cryostat cause an influx of heat, resulting in evaporation of the cryogen. For liquid helium applications especially, it is important to minimize this heat influx, and several studies have resulted during the past decade. Here, all the available experimental data are reviewed to support a simplified design procedure for optimum gas-cooled leads. The present and predicted efficiency of electrical leads is discussed, and recommendations are made for future research. (auth)

47268 VALUES IN ATOMIC INDUSTRY AND THE VACUUM INDUSTRY. Gazal, C. Bull. Inform. Sci. Tech. (Paris), No. 126, 39-49(May 1968). (In French).

A review is given of the special qualities required in all values used in nuclear facilities (choice of materials, tightness, reliability, cleanliness). Some particular achievements in this field are described. A few types of values used in vacuum circuits are then described. (auth)

47269 THERMAL BEHAVIOR DURING A FIRE INCIDENT OF A [FUEL] TRANSPORT CONTAINER HAVING A WIRE PROTECTION CAGE. Cuoco, Aldo; Pesce, Guido (CNEN, Rome). Ing. Nucl., 9: No. 2, 3-12(Mar.-Apr. 1968). (In Italian).

The design of spent fuel shipment casks for the Ispra research facility is described; drawings are shown. A safety analysis of the cask is given; cask integrity during a standard fire is analyzed. Heat transfer analyses are detailed; and thermal balance equations are formulated. (M.L.S.)

47270 POSITIONING DEVICE FOR A RADIATION SHIELD HAVING MEANS FOR COOLING SAID SHIELD. Moore, Vernon L. (to Phillips Petroleum Co.). U. S. Patent 3,395,279. July 30, 1968. Filed Nov. 30, 1964.

A rotary off-center shield is described that is mounted in a vacuum chamber which may be rotated to stop or pass a beam of radiation. This shield is further provided with electrical insulation and liquid cooling means which greatly increase the effectiveness of the entire assembly when the beam of radiation contains large amounts of energy. (auth)

47271 IRRADIATION EQUIPMENT WITH MEANS TO CONVEY GOODS AT A NON-UNIFORM SPEED PAST A RADIATION SOURCE FOR MAXIMUM EXPOSURE. Brunner, Alfred (to Sulzer Brothers Ltd.). U. S. Patent 3,396,273. Aug. 6, 1968. Priority date Apr. 13, 1964, Switzerland.

An irradiation facility is described in which the packages being irradiated are moved about a pair of parallel tracks so that the packages on the inner track shield the packages on the outer track when aligned relative to the radiation source. The movement of the packages is intermittently interrupted to permit exposure of the outer packages for a maximum time during which the outer track packages are unshielded and a minimum time of nonexposure when shielded. (auth)

47272 DEVICE FOR REMOVING THE LID OF A RADIOISOTOPE CONTAINER. Amano, Makio (to Ishikawajima-Harima Heavy Industry Co., Ltd.). Japanese Patent 1968-4920. Feb. 22, 1968. Filed Sept. 25, 1964.

The lid of a radioisotope container can be removed remotely to take out the radioisotope. An electric motor is set within a box, with its rotor axis in the vertical direction; the motor itself is rotatable horizontally. A rod, one end of which is fixed at the corner of the motor, extends to the container-holding plate on the outside of the box top; by rotating the motor, the plate can hold or release the container through the rod. A means is provided for converting the (motor) rotor rotation into the vertical movement of a cylindrical body directly above the rotor rod. The container with a radioisotope is set, upside down, appropriately in the box top. When the upper end of the cylindrical body reaches to the container lid, the protrusions on the former are inserted into the corresponding holes in the lid. Then, in this condition the cylindrical body is rotated, to remove the lid from the container. A means is provided to absorb the dropping shock occurring after the removal. (NSA of Japan)

47273 INTERLOCKING MECHANISM. Tsuki, Tadaichi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-7520. Mar. 21, 1968. Filed Oct. 28, 1964.

The interlocking mechanism proposed can be suitably used for an irradiation facility. Without the shutter interfering with the radiation source, or vice versa, the source can move after complete opening of the shutter, and the shutter is closed after complete containment of the source. It consists of a means for driving the first object through a gear system by a motor, and a means for driving similarly the second object. Included are a first and second gear, on the same axis, connected to the first and the second object, respectively. Stoppers, installed in each gear determine the rotation angle of the respective gears. Holes are designed in the groove of the two gears, and sleeves (with pins) between the hole and groove, both not interfering with each other. The resulting interlocking mechanism is such that the second object starts its movement after the first object has finished its own, and vice versa. (NSA of Japan)

47274 IRRADIATION FACILITY. Tsuki, Tadaichi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-10360. Apr. 30, 1968. Filed Jan. 12, 1965.

A defect occurring in the irradiation facility can be repaired in a safe manner using the method described. The irradiation facility consists of the water pool in which sample irradiation is performed; an irradiation table, immersed in pool water, on which a radiation source and irradiation samples are placed; and, a mechanism for lifting or lowering the table in the water pool. The table can be inclined, to drop a radiation source onto the pool bottom, when a defect occurs in the mechanism during its operation. (NSA of Japan)

47275 MOVABLE OPERATOR SHIELDING ENCLOSURE FOR HANDLING RADIOACTIVE MATERIAL. Ziegler, A. (to Siemens-Schuckertwerke Aktiengesellschaft). Canadian Patent 786,441. May 28, 1968. Priority date Mar. 8, 1963, Germany.

Servicing personnel are protected within a freely movable cabin which has its own radiation shielding. Working operations and movement are controlled from inside as the enclosed operator moves about in a radioactive environment. Though the chamber is necessarily heavy because of the shielding required, the inside pressure is maintained above that of the surroundings so that the air is radiation-free and the hovercraft principle of an air cushion beneath is used for easy movement. Method of entry and exit, and means of controlling movement and tool operations are described. One or more gloves of radiation impermeable material allow facile manipulation of exterior objects. (F.S.A.)

47276 EXPERIMENTS WITH HYDRODYNAMIC JOURNAL BEARINGS OF VARIOUS MATERIALS AND DESIGNS IN SODIUM

AT TEMPERATURES TO 800°F. Schuller, Frederick T.; Anderson, William J.; Nemeth, Zolton (Lewis Research Center, Cleveland). ASLE (Amer. Soc. Lubric. Eng.) Trans., 11: 140-54(Apr. 1968).

Hydrodynamic journal bearing experiments were run in sodium at 500 and 800°F at speeds to 12,000 rpm and unit loads to 31.1 psi. Five different configurations were tested. Tilting pad bearings were the most stable. Following in order were: plain cylindrical bearing with a herringbone groove journal, 3-axial groove bearing, pressure fed from an axial shaft pump through a hole in the journal, and 3- and 2-axial groove bearings. Co–Cr–W, J material mated with Ni–Cr–Fe–Mo, X, titanium carbide (K184B), or Ni–Cr showed the best wear and seizure properties. Also titanium carbide (K184B) mated with Mo – 0.5Ti showed excellent promise. Materials having high nickel content, such as Ni–Cr–Fe–Mo, X and Ni–Cr, were prone to catastrophic seizure when paired in a bearing and journal combination. Data on the threshold of instability of circular, grooved bearings obtained from this investigation compared favorably with predicted theoretical values. (BBB)

47277 SHIPPING CONTAINER FOR RADIUM. Public Health Rep. (U.S.), 83: 496(June 1968).

A container which prevents Ra losses during shipment was developed as a means of eliminating a cause of environmental contamination by radiation. The shipping container is reusable. It was designed specifically for medical Ra capsules and needles in the commonly used sizes. It may be adapted readily, however, for Ra–Be neutron sources and may be modified to provide a container for plaques and nasopharnygeal applicators. The container is an interlocking of interior and exterior containers. These cannot be closed until one has been fastened to the other so that there can be no internal movement or accidental opening during shipment. The interior container is in 3 sizes, each made to hold a maximum of 50, 150, or 300 mg of Ra. Each size is fabricated in 2 parts of threaded hexagon brass stock with bottom portions drilled to receive a limited number of Ra capsules or needles of a given size. Bottoms and tops are tightened against a metal gasket to prevent leakage of radioactive gas which could occur with leaking Ra needles or capsules. The interior container is also locked into the center of a cylindrical lead-lined shield by a plug-shaped closure and held by a spring-loaded device. The plug may be inserted and locked into the shield by a spring-loaded bayonet type lock, but only if the interior container has been properly positioned in the plug and is of a size suitable for a given shield. The exterior container, an 18-in. cube constructed of $\frac{1}{4}$-in. plywood and metal corner moldings, is sized to meet, with a minimum amount of lead shielding, the dose rate requirements of transportation agencies. (BBB)

47278 MECHANICAL SEMI-PERSISTENT SWITCHES FOR SUPERCONDUCTING SOLENOIDS. Atherton, D. (Ferrantic Packard Electric Ltd., Toronto). Cryogenics, 8: 248-9(Aug. 1968).

Mechanical switches with effectively open circuit resistances are attractive for many applications if low enough "closed" state resistances producing long time constants can be obtained. Modern magnet inductances are typically of the order of several Henries, so that a microhm circuit resistance yields a 1 in 10^4 stability for several minutes. The design and test of such a switch is described. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 47266, 47883, and 47886.

47279 (AERE-R-5390) MEASUREMENT OF COOLING-WATER FLOW AT EGGBOROUGH POWER STATION. Aston, M. A. J.; Boyce, I. S.; Clark, W. E.; Clayton, C. G.; Evans, G. V.; Spackman, R. (United Kingdom Atomic Energy Authority, Wantage (England). Research Group). June 1968. 31p. Dep. CFSTI. UK 4s. 6d.

A series of measurements to determine the efficiency of one of the cooling-water pumps at Eggborough Power Station is described. The highest accuracy and precision were required in all the measurements in these tests. Of several radioisotope methods which were considered, the constant-rate-injection method sodium-24 was chosen as being the most suitable tracer. The techniques which were used to measure the cooling-water flow are described, together with an analysis of the origin and magnitude of errors associated with each part of the flow-measuring process. (auth)

47280 (AERE-R-5569) DISPERSION AND MIXING DURING TURBULENT FLOW OF WATER IN A CIRCULAR PIPE. Clayton, C. G.; Ball, A. M.; Spackman, R. (United Kingdom Atomic Energy Authority, Wantage (England). Research Group). May 1968. 33p. Dep. CFSTI. UK 5s. 0d.

The dispersion of a tracer continuously injected into a 4 in. dia pipe containing water in turbulent motion was investigated experimentally over the flow range $5 \times 10^3 < Re < 5.5 \times 10^5$ by observing the distribution of the tracer over various cross-sections downstream from the injection region. The effect of four different injection systems was examined and it was found that, of the arrangements tried, the shortest mixing distance occurs when the tracer is injected through equally spaced orifices at a radius of 0.63 in. of the pipe radius. A small increase of mixing distance with increasing Reynolds number was established. The agreement between the experimental results and results derived theoretically was sufficiently close for the theory to be considered of general practical use. (auth)

47281 (ANL-7353) SURFACE-RENEWAL MODELS FOR HEAT TRANSFER BETWEEN WALLS AND FLUIDIZED BEDS. Patel, R. D. (Argonne National Lab., Ill.). Nov. 1967. Contract W-31-109-eng-38. 110p. Dep. CFSTI.

Work was performed to develop a model to describe heat transfer from wall surfaces in a fluidized bed and to demonstrate the model's accuracy experimentally. Models previously presented are reviewed. The equipment and procedures used to measure heat-transfer coefficients and particle residence times at the identical wall surface under the same conditions are described. Heat transfer coefficients were measured for cellulose acetate, glass, copper, aluminum, and alumina in sizes ranging from 0.001 to 0.01 ft. Residence times were measured for only the glass and cellulose acetate. The residence times for other particles were obtained from a dimensionless correlation between residence time and gas velocity using the glass and acetate data. Air was used as the fluidizing gas. Two surface-renewal models are presented. Both gave predictions within an average 30% of the data for glass. For the other systems, the deviation was greater. (L.C.L.)

47282 (BMwF-FBK-68-18) EXPERIMENTS FOR SIMULATING HEAT TRANSFER FROM A REACTOR SURFACE TO CESIUM VAPOR CONVERTERS. Koeppe, A. (Stuttgart Univ. (West Germany)). Feb. 15, 1968. 17p. (In German). Dep.

Experiments for simulating heat transfer by radiation from a reactor surface to a thermionic converter with a heat pipe-radiator are described. A cesium diode for a SRAST-W system was built and a description in terms of design and data is given. The results of measurement on a front wall heated heat pipe are discussed. Technological problems of a cesium diode by electron beam welding are considered. (auth)

47283 (GEMP-614) A BRIEF GUIDE TO THE USE OF VERSION E OF THE TRANSIENT HEAT TRANSFER COMPUTER PROGRAMS (NMP-857). Skirvin, S. C. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). June 6, 1968. 41p. Dep. CFSTI.

Instructions are presented for use of Version E of the Transient Heat Transfer computer programs (THTE). These instructions are minimal in the sense that they are not self-contained, but supplement the THTD User's Manual. THTE computes transient and steady-state temperature distributions in large generalized three-dimensional systems, but is faster and potentially more accurate than THTD. In addition, THTE computes flow and pressure drop for one-dimensional, single phase gases and liquids on a steady-state or pseudo-transient basis. THTE has not been fully implemented and has received only limited production use. The status of checkout is indicated. (auth)

47284 (LA-3986) QUARTERLY STATUS REPORT ON THE SPACE ELECTRIC POWER R AND D PROGRAM FOR THE PERIOD ENDING JULY 31, 1968. PART I. (Los Alamos Scientific Lab., N. Mex.). Aug. 23, 1968. Contract W-7405-eng-36. 6p. Dep. CFSTI.

Heat transfer experiments with Na and K in annular return heat pipes have shown that large capillary forces can develop in such a pipe if a tube of five porosity separates the liquid return path from the vapor passage. The procedure for fabricating porous tubes from several layers of five-mesh screen is described. Methods for determining the pore size of the tubes and the capillary force that can develop in the finished product are discussed. (R.C.K.)

47285 (SAN-677-29) INVESTIGATION OF FUNDAMENTAL MECHANISMS AND PARAMETERS THAT INFLUENCE STEADY STATE AND TRANSIENT PERFORMANCE OF RANKINE CYCLE LIQUID METAL SYSTEMS. Annual Report, July 1, 1967–June 30, 1968. Poppendiek, H. F.; Greene, N. D.; Goddard, W. B.; Sabin, C. M. (Geoscience Ltd., Solana Beach, Calif.). Contract AT-(04-3)-677. 72p. Dep. CFSTI.

A program was undertaken to determine the phase distribution in an actual liquid metal boiler by direct observation. The experimental work included construction of a transparent observation section or port in a boiler tube, development of microscopic

photography techniques, and the photographing of phase distributions in air-mercury, boiling Freon, and boiling mercury in forced, convective, two-phase flow under linear and helical flow conditions. The equipment and procedures are described in detail. Results of the boiling mercury phase distribution experiments are presented. These include photographic phase distribution data obtained at known vapor qualities with both heated and non-heated observation ports during linear and helical boiling mercury flow, heat transfer conductance measurements, mercury vapor quality determinations, and their interrelationships. (L.C.L.)

47286 METHOD OF DETECTING AND/OR MEASURING INTERNAL LEAKAGE IN A PROCESS STREAM. Ackerman, Carl D.; Mott, William E. (to Gulf Research and Development Co.). U. S. Patent 3,370,173. Feb. 20, 1968. Filed Mar. 19, 1964.

A method of measuring bypassing in a continuous stream process system without removing a sample of the stream from the process system is described. A known quantity of a radioactive halogen–tagged tracer is injected into the process stream upstream of a point of possible bypassing. The radioactive tracer from the process stream flowing through that portion of the system possibly being bypassed is removed by contacting the process stream with a halogen adsorptive material. The quantity of radioactivity of the process stream downstream from the point of possible bypassing is detected externally of the system. Therefore, the quantity of radioactivity detected is indicative of the extent of bypassing. (auth)

Isotope Technology

Refer also to abstracts 47090, 47279, 47280, 47286, 47304, 47399, 47415, 47674, 47701, and 47869.

47287 (AERE-R-5500(Vol.2), pp 462-79) UNCONVENTIONAL NUCLEAR POWER SOURCES. Sanders, L. G.; Yeats, F. W.; Poole, M. J. (Atomic Energy Research Establishment, Harwell (England)).

During the last four years, low-powered thermoelectric generators using ^{90}Sr as the heat source have been developed. The thermoelectric materials chosen for these are bismuth telluride/antimony telluride alloy and bismuth telluride/bismuth selenide alloy. Using these, generators with powers ranging from 90mW(e) to 5W(e) have been designed, and a number of generators with initial output powers up to 1.6W(e) manufactured and tested. These small generators have a conversion efficiency of 2.7% and an end-of-life useful efficiency of 1.7%. The possibility of making higher-power isotope sources is discussed and methods of energy conversion are briefly reviewed. It is concluded that thermoelectric generators are the most suitable at powers up to 100 watts, but that above this power other conversion systems (dynamic or thermionic) begin to compete. The discussion of isotope generators concludes with an examination of the possibility of using raw fission products as fuel for a larger generator. Another unconventional power source is the thermionic reactor. This gives the possibility of generation of electricity without moving parts to give any output from a few kilowatts to many megawatts at an efficiency of around 15%. The advantages of the direct conversion reactor over more conventional systems are discussed. (auth)

47288 (AERE-R-5500(Vol.3), pp 594-607) APPLICATION OF RADIOISOTOPE TRACERS TO SPOIL GROUND SELECTION. Smith, D. B. (United Kingdom Atomic Energy Authority, Wantage (England). Research Group).

A technique using radioactive tracers for the investigation of the movement of silt from spoil grounds is described. Two examples of investigations in the Thames Estuary and the Firth of Forth illustrate the use of the results in the evaluation of spoil movement in the estuaries and in the selection of suitable spoil grounds. (auth)

47289 (AI-AEC-12712) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 4. T-111 PRESSURE VESSEL DEVELOPMENT AND FABRICATION. Williams, J. S.; Ferry, P. B. (Atomics International, Canoga Park, Calif.). July 25, 1968. Contract AT(29-2)-2338. 63p. Dep. CFSTI.

The Large Radioisotope Heat Source Capsule (LRHSC) Program is developing technology for high temperature (2000°F) long life (5 years or longer) heat sources which can be used in the space environment. The LRHSC program is specifically concerned with the development of a tantalum alloy fuel capsule. Data are to be obtained under conditions of biaxial creep, impact and burial, and included strain, compatibility and thermal maps. Results for the critical process of deep drawing the tantalum alloy T-111 are presented. Since this process represents a "first" for such extreme 1/d ratios with the T-111 alloy, close documentation of the process has been conducted. Details of tooling development and checkout, and the history of problems and solutions encountered during the development effort are given. At this point, the process can be considered "state-of-the-art". (auth)

47290 (AI-AEC-12713) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC). Fourth Quarterly Progress Report, April–June 1968. (Atomics International, Canoga Park, Calif.). Aug. 15, 1968. Contract AT(29-2)-2338. 55p. Dep. CFSTI.

Progress is reported on the development of a large radioisotope heat source capsule capable of operating in a space environment at a surface temperature of about 2000°F for five years or more. The objectives of the program are to design, fabricate, test and evaluate a test capsule whose design takes into account the operating requirements of a typical heat source. In addition to indicating the suitability of the reference capsule for ground test, the data generated will be used to validate presently accepted design approaches and define margins that would actually exist for high temperature capsules intended for flight systems. Progress is reviewed on the following tasks: program management; process development; fabrication and assembly; capsule creep testing; coupon compatibility and coating development; and soil burial tests. (R.C.K.)

47291 (BMwF-FBK-68-07) STUDY OF PHOTO-VOLTAIC CONVERSION. Lorenzen, K.; Born, H.-J. (Technische Hochschule, Munich (West Germany). Institut fuer Radiochemie). Mar. 1968. 24p. (In German). Dep.

The behavior of ^{147}Pm–ZnS luminous compounds was investigated. Mechanical and chemical treatments yielding a change in luminosity were investigated by exciting the ZnS by an external β-emitting source. ^{147}Pm luminous compounds show an effect of aging, which was investigated and compared with the aging by irradiation with ^{60}Co γ rays. The absolute values of the luminosity were determined up to 25 Ci ^{147}Pm/g ZnS. (auth)

47292 (K-Trans-38) SEPARATION OF STABLE ISOTOPES. Chen, Wang. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from Hua Hseuh Tung Pao, No. 8, 458-68(1963). 31p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 18: 4146.

47293 (MND-P-2368) OPERATIONAL AND SYSTEM TESTING OF SNAP 3 THERMOELECTRIC GENERATOR. Wilson, Robert J. (Martin Co., Baltimore, Md. Nuclear Div.). Jan. 1961. Contract AT(30-3)-217. 29p. (RP-61-2-37). Dep. CFSTI.

The electrical performance of the SNAP 3 generator in a variety of environments has been accurately defined through test. A total of 2593 hours has been amassed, during which these units have been subjected to the shock, acceleration and vibration fields anticipated in the boost phase of a satellite launching. Additional performance tests have provided voltage-amperage relationships, with thermal input as the parameter, under simulated space conditions. Ambient temperatures ranged from +70° to −100°F, with the unit suspended in an evacuated chamber. A method developed to change the insulation conductivity with time provides a constant thermal input to the thermoelectric conversion unit. A constant electrical output is produced, although the total thermal energy available decreases with time as a function of the isotope half-life. An essential adjunct to performance definition has been the determination of the safety of a radioisotope power unit in combination with a vehicle system. A brief summary covers the results of tests simulating the critical situations encountered in typical missions. (auth)

47294 (TID-24349) DIVISION OF ISOTOPES DEVELOPMENT RESEARCH AND DEVELOPMENT PROJECTS, 1967, Progress Reports on Sponsored Work. Lafferty, Robert H. Jr.; Carden, Joan E. (eds.) (Oak Ridge National Lab., Tenn.). May 1968. 284p. Dep. CFSTI.

Includes Addendum 1.

A short summary of objectives, results, and future plans for each research and development project sponsored by the Division is presented. The major program areas are radioisotope production, thermal applications, environmental and ocean sciences, radiation analysis and control, radiopreservation of foods, process radiation, and radiation engineering. (C.E.S.)

47295 SUIT HEATER. Grega, Michael G. (to United States Atomic Energy Commission). U. S. Patent 3,402,708. Sept. 24, 1968.

An apparatus for heating suits for swimmers or astronauts who may be subjected to cold water or space environments is described.

It utilizes an outer container spaced from an inner container with the inner having a holder for a radioisotope heat source to furnish heat to fluid that is pumped through conduits or passageways of the apparatus and garment; means is provided for selectively by-passing fluid to vary the temperature of fluid pumped through the passageways of the suits. (AEC)

47296 SUIT HEATER. Shivers, Rufus W.; Beckman, Edward L. (to United States Atomic Energy Commission). U. S. Patent 3,402,709. Sept. 24, 1968.

An apparatus for heating suits for swimmers or astronauts who may be subjected to cold water or space environments is described. The equipment includes a container having radioisotope heat source capsules, a first conduit and pump for transmitting heated fluid from the container to passageways in the suit and back to the container, a fluid bypass conduit and valve connected to the first conduit in advance of the suit for diverting heated fluid back to the container and for cooling the fluid so as to control the temperature of the suit. (AEC)

47297 SYMPOSIUM ON INDUSTRIAL USES OF RADIOISOTOPES, UNIVERSITY OF NEW SOUTH WALES, AUSTRALIA, OCTOBER 25-27, 1967. Sydney, Southern Cross International, 1968. 198p. (CONF-671065). Kensington, Australia, Unisearch Ltd., 1968, $5.95.

The industrial use of radioisotopes in Australian industry is discussed under the following headings: radioisotopes and radiation in industry; commercial processes employing massive radiation doses; industrial aspects of radiation; ionizing radiation for sterilization; radiation chemical synthesis of graft polymers; application of x-ray sources to the analysis of materials; application of radioisotopes to the paper industry; radioisotopes for industrial radiography; use of radioisotopes for analysis of ores and slurries; solving industrial problems by use of radioisotopes; use of radioisotopes in the steel industry; industrial and field investigations using radiotracers; radiation in the food industry; and ionization radiation as an industrial processing tool. (R.C.K.)

47298 SEPARAZIONE ISOTOPICA DELL'URANIO. (Isotopic Separation of Uranium). Caldirola, Piero; Fiocchi, Roberto. Serie Trattati. Rome, Comitato Nazionale Energia Nucleare, 1967. 448p.

The available information on the theoretical principles, construction characteristics, and the economic aspects of the various industrial and experimental procedures for the separation of uranium isotopes is compiled and presented in synthetic form. The characteristics of uranium and its isotopes and the importance of the element in the nuclear industry are first outlined. The chief elements of fluid physics are discussed and the physical principles of the isotopic separation of uranium are given. The theory of gaseous diffusion separation, production and testing of porous barriers for gaseous diffusion separation, theory of cascade separation, combination of cascade separation with gaseous diffusion separation, and isotopic separation by centrifugation are considered. The primary bibliographic sources are reports and original articles from researchers in the countries with a nuclear industry. (J.S.R.)

47299 IRRADIATION DEVICE. Yamaguchi Hiroshi (to Hitachi Ltd.). Japanese Patent 1968-10480. May 1, 1968. Filed Feb. 27, 1964.

An irradiation device is described that allows the source to be brought closer to the object. It consists of a massive (radiation-source) container, with an irradiation hole on one side and another hole penetrating the container wall on the opposite side. A disc-shutter, rotating within the container on the container horizontal axis, through which a hole penetrates in the diameter direction at right angles to the said axis is included along with a cylindrical source holder, sliding through the hole in the disc, with a source attached at the outer end. A spring to exert an inward force on the source holder, a means for rotating the shutter disc, and a rod for pushing the source and its holder to the correct position at the irradiation hole by rotation of the disc shutter are included. (NSA of Japan)

47300 ENRICHMENT OF ^{18}O OF HIGH CONCENTRATION BY THERMAL DIFFUSION METHOD. Yamamoto, Masao; Takahashi, Masashi; Imaoka, Masohiro; Hashioka, Toshiyuki; Hirota, Kozo (Osaka Univ.). Nippon Kagaku Zasshi, 89: 839-43(Sept. 1968). (In Japanese).

Enrichment of ^{18}O was carried out by using thermal diffusion columns with 1.0 to 3.0 atom % ^{18}O oxygen gas as the starting material. The maximum ^{18}O concentration attained was 80.8 atom % in 72 days with the apparatus of overall effective length 22.85 m (8 stages), and the transported amount was 2.6 ml ($^{18}O_2$)/day. With another apparatus of overall effective length 14.0 m (5 stages), the ^{18}O concentration attained was 69 atom % in 46 days, and the transported amount was 3.6 ml ($^{18}O_2$)/day. By using the second apparatus, 150 ml of 60 atom % ^{18}O oxygen gas or 250 ml of 25 atom % ^{18}O oxygen gas could be obtained. (auth)

47301 TAPPET WEAR MEASUREMENTS BY MEANS OF RADIONUCLIDES. Moeller, Uwe J. (Esso AG, Hamburg). Erdoel Kohle, 21: 285-90(May 1968). (In German).

Tests of tappets prepared from radioactive components were used to describe wear conditions; the procedure for testing by radiation techniques is described. Radioactive particles worn off the tappets could be analyzed by a sampling procedure with a statistical error of 10%, after calibration with tappet material of known activity and quantity in the mg region. Correction factors must be applied for radioactive decay during the testing period, for differing individual activities, and for the loss of active material in lubricating oil. Test procedures are described for tappets with an activity of 10 mCi. Results indicated that wear depends mainly on motor oil at mating parts and operating conditions; the normal wear rate is also influenced by the weight % of P to the % of metal in the tappet. (BBB)

Materials Testing

Refer also to abstracts 47293, 47393, 47401, and 48808.

47302 (AERE-R-5732) A NONDESTRUCTIVE MEASUREMENT OF THE FLUCTUATIONS IN AREA DENSITY OF A GRAPHITE BLOCK USING A 147-MeV PROTON BEAM. Bell, Ronald A.; Clements, P. J.; Langsford, A. (Atomic Energy Research Establishment, Harwell (England)). May 1968. 11p. Dep. CFSTI. UK 2s. 6d.

The fluctuations in area density (mass per unit area) over a disc of high density graphite, 45 mm diameter and 14 mm (25.0 kg m^{-2}) thick, were measured using a 147 MeV proton beam as a non-destructive probe. An accuracy of ±0.08 kg m^{-2} at each point, and a spatial resolution of 3 mm was obtained. It was concluded that the technique is capable of giving, for samples up to 100 to 200 kg m^{-2} thick, an accuracy of ±0.003 kg m^{-2} or ~1% of the value of the fluctuation, whichever is the greater, and a spatial resolution of less than 1 mm. For the thickest targets the method is potentially ~100 times more accurate than standard methods based on the transmission of radiation from radioisotopes. (auth)

47303 (BNWL-817) AN IN SITU WELD DEFECT DETECTOR ACOUSTIC EMISSION. Jolly, W. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 28p. Dep. CFSTI.

The application of acoustic emission to the detection of weld defects during and immediately following the welding operation is described. Both manual and machine welds fabricated by the gas tungsten-arc process produce acoustic emission. Acoustic emission from welds in 304L and 316 SS is examined in detail. A correlation is made between acoustic emission rate and radiographic analysis data. A relationship between acoustic emission rate and weld defect region temperature is demonstrated. Acoustic emission pulse characteristics and spectral power distribution are presented. Problems involved in locating weld defects by means of acoustic emission signals are discussed. (auth)

47304 (SC-CR-68-3640) A FAILURE-RESISTANCE EVALUATION OF $^{238}PuO_2$ MICROSPHERES UNDER SIMULATED ENVIRONMENTAL CONDITIONS. Askey, Daniel F. (Battelle Memorial Inst., Columbus, Ohio). Feb. 1968. 28p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

The resistance of $^{238}PuO_2$ microspheres to spallation and fragmentation under environmental conditions simulating isotopic-heat source catastrophic failure under reentry was evaluated. Small test samples of uncoated microspheres were subjected to a helium environment at 1300°F and 2500 psi and rapidly depressurized in time periods as short as 25 millisec with no apparent loss of particle integrity. (auth)

Protective Structures

47305 (CONF-680527-1) ANALYTICAL STUDY OF FIRE SERVICE OPERATIONS IN NUCLEAR DISASTERS. Martin, Stanley B.; Ramstad, Robert W.; Staackmann, Milton (URS Corp., Burlingame, Calif. Burlingame Research Div.). May 1968. 37p.

From 72nd NFPA Annual Meeting, Atlanta, Ga.

A quantitative prediction of the nuclear fire threat and the demands associated with it are used to prescribe realistic fire-service goals and to suggest modifications of fire-service tactics as guidelines to planning for nuclear disasters. (auth)

Radioactive Material Handling

Refer also to abstracts 47264 and 47277.

47306 (BNWL-771) FIXATION OF RADIOACTIVE RESIDUES. Research and Development Activities Quarterly Progress Report, November 1967-January 1968. Platt, A. M. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1968. Contract AT(45-1)-1830. 41p. Dep. CFSTI.

During pot calcination Run PC-6, 1,300,000 Ci of radioactivity was processed in a 8-in. pot. The 5100 W of heat generated by this radioactivity was sufficient to produce a maximum calcine temperature of 940°C at the pot centerline, and a pot centerline to wall ΔT of 700°C with the pot handing in air. Approximately 2,000,000 Ci of radioactive waste was successfully processed in the first three radioactive phosphate glass runs in Waste Solidification Engineering Prototypes (WSEP). These demonstrations represented the first conversion of highly radioactive wastes into glass on an engineering scale. Non-radioactive development work on spray solidification indicated that (1) batch dumping of a PW-2 melt into an unheated mild steel container is feasible, and (2) the filterability of the calcine from a PW-1 in-pot melting flowsheet is greatly improved by adding a portion of the $NaPO_3$ to the feed, as compared to the previously used technique of adding all the flux in solid form to the melt pot. Precipitation of sulfates from simulated glass melter condensate was investigated, chiefly as a barium compound. The precipitates were not suitable for retention in asphalt. Cement retention of ^{137}Cs, with addition of one percent by weight powdered Zeolon, was improved. A flowsheet for treatment of glass melter condensate by vacuum distillation was prepared. The flowsheet will be demonstrated in future hot cell work. (auth)

47307 (EUR-3485(Vol.2)) EXAMINATION OF THE INTERNATIONAL ATOMIC ENERGY AGENCY'S REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. STUDY OF THE BASIC ELEMENTS OF THE TYPE A PACKAGING TESTS AND PRACTICAL SUGGESTIONS FOR RADIOISOTOPE PACKAGING. Final Report. (Philips-Duphar N. V., Petten (Netherlands). Cyclotron en Isotopen Laboratorium). June 1968. 74p. Dep.

The aim of the investigation was to assess the value of the tests laid down in the IAEA regulations and to devise practical solutions for the design and construction of type A packagings, taking as a basis the present situation as regards radioisotope transport methods and the packagings currently used by isotope centers. To this end a study was made of the relevant literature and the existing test methods for normal commercial products with a view to applying this experience to the transport of radioisotopes. At the same time, an enquiry was conducted among 45 institutes and firms all over the world, of whom 25 sent in replies and in some cases also submitted packaging for testing. Detailed drawings were prepared illustrating the construction of all components of these packagings and the quality of the materials used is described in the final report; these packagings were then subjected to the tests laid down in the IAEA Regulations for Safe Transport of Radioactive Materials, 1964, Revised Edition, Annex IV. The test results were recorded in a series of photographs and descriptions that were embodied in an explanatory text. On the basis of the literature data, the analysis of the replies received to the questionnaire and the results of the tests carried out, recommended test procedures were drawn up for cardboard packagings of limited total weight for the transport of radioisotopes. Two scale-models are provided of packagings which satisfy these test requirements together with a report on the general construction, the quality of the materials to be used and the composition of the various parts. (auth)

47308 DEVICE FOR CONVEYING A RADIATION SOURCE. Imai, Ken (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-13838. June 12, 1968. Filed Aug. 10, 1965.

The device design is for moving a radiation source between two adjoining cells through the partitioning wall. The advantages to the method are complete containment of a radiation source and its conveyer mechanism within the partitioning wall when the source is not used, movement deep into each cell of the source, and economical use of the two cells. It consists of two adjoining irradiation cells partitioned by a shielding wall, an opening through the wall connecting the two cells, shutters installed on either side of the opening, a conveyer base traveling through the opening, a source support movable on the base in the same direction, and a container for the source. (NSA of Japan)

47309 CASK FOR TRANSPORTING A RADIOACTIVE LIQUID. Mazaki, Gengo (to Mitsubishi Atomic Power Industry Inc.). Japanese Patent 1968-8675. Apr. 3, 1968. Filed June 10, 1964.

When a radioactive liquid is introduced into the transport cask or withdrawn from it, the escape of such liquid into the surrounding area can be prevented. The transport cask consists of the massive outer container with a massive lid, a containing bottle with a massive top placed within the outer container, and two tubes running through the two lids as the paths for a radioactive liquid and a gas respectively. These two tubes are connected to or disconnected from the respective external tubes by means of the couplings, just outside the lid of the outer container. (NSA of Japan)

47310 DISPOSAL OF WASTES FROM ATOMIC ENERGY ESTABLISHMENTS. Seth, G. K. (CPHERI, Hyderabad, India). Environ. Health, 8: 254-61(1966).

The problem of disposal of radioactive wastes from radiochemical separation plants, nuclear power reactors, and places where radioisotopes are used in research, medicine or industry is discussed. Suggestions are given for the safe disposal of these wastes. (Indian Sci. Abstr.)

Vacuum Engineering

Refer to abstracts 47268 and 47668.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 47243.

General Detectors and Monitors

Refer also to abstracts 47234, 47386, 47387, 47441, 47443, 47863, 47894, 48421, 48509, and 48747.

47311 (BNWL-715(Pt.1), pp 1-15) INTERPRETING COUNTING DATA FOR INTERNALLY DEPOSITED PLUTONIUM. Swinth, K. L. (Battelle-Northwest, Richland, Wash.).

Developmental, sensitive counters presage enhanced measurement of internally deposited plutonium by counting the low-energy photons (17 keV x rays, 60 keV ^{241}Am gamma) emitted by the plutonium. General factors influencing the interpretation of counting data include the change in photon emission rate with variable isotopic composition, the low penetrating power of the radiations, and the variable background due to high-energy radiations of other isotopes. The 17-keV plutonium x rays show a half-value thickness for tissue of only 0.6 cm; hence, factors changing the absorption such as internal distribution, surface contamination, and variable overlying tissue masses, affect the interpretation of counting measurements. Data from phantoms and animals indicate the relative importance of these factors. Methods of correcting for such effects are discussed. Background variations become critical for low-level counting and data show that differences in low-energy (~17 keV) backgrounds of greater than a factor of two can be expected. Finally, the role of pulmonary clearance effects as related to counting are discussed. (auth)

47312 (BNWL-715(Pt.1), pp 20-9) MEASUREMENT OF THE PHOTON-TO-ALPHA RATIO FOR PLUTONIUM ISOTOPES. Swinth, K. L. (Battelle-Northwest, Richland, Wash.).

Accurate use of either the L x rays from decaying plutonium isotopes or the 60-keV ^{241}Am gamma ray in making health physics or radiochemical determinations depends in part on a knowledge of the specific activity and/or isotopic composition of the materials. Specific activities, i.e., x rays/α, gamma/α, etc., however, vary with isotopic composition which is not always known. The development of techniques for the sensitive measurement of the x/α ratio to be used in comparing and/or evaluating the radiological hazard and isotopic composition of plutonium sources is discussed. Two systems, a proportional counter-scintillation counter combination and a solid state arrangement, are described and evaluated. (auth)

47313 (BNWL-715(Pt.1), pp 29-38) DEPENDENCE OF PLUTONIUM X-RAY COUNTING ON ISOTOPIC COMPOSITION. Swinth, K. L. (Battelle-Northwest, Richland, Wash.).

Plutonium materials may often be analyzed by counting the low energy photons emitted (17-keV x rays, 60-keV ^{241}Am gamma). Since the specific activity and the yield of x rays vary among the plutonium isotopes and ^{241}Am, and plutonium samples differ in isotopic composition, difficulties arise during analysis of the amount of plutonium present or of the alpha particle activity (dose rate). Calculations explored the changes in x-ray and γ-ray activity of plutonium with isotopic composition and time. For a source containing 90% ^{239}Pu by weight, 55% of the total x-ray activity results from the ^{239}Pu, but this falls to 27% after a 5 yr decay. This change with time results mainly from the decay of ^{241}Pu to ^{241}Am. A typical source containing 94% ^{239}Pu and 0.08% ^{241}Am by weight has a calculated x/α ratio of 0.063 and a 60-keV gamma/α ratio of 0.013. Problems and experiments pertaining to a number of different isotopic compositions which relate to the maximum permissible body burden (MPBB) for the material are discussed. (auth)

47314 (BNWL-715(Pt.1), pp 41-3) SURFACE CONTOURED DIODE APPLICATIONS. Swinth, K. L. (Battelle-Northwest, Richland, Wash.).

The availability of surface contoured diodes for use as charge multiplication detectors of low energy x rays, permits new approaches to improved plutonium wound counting techniques. Although the diodes evidence low detection efficiencies, their small and low background count rates offer some advantage over more conventional approaches. Several different configurations, including a hypodermic needle probe, are investigated for possible use. Advancing technology will produce a variety of possible applications as better units become available. (auth)

47315 (BNWL-715(Pt.1), pp 54-60) NEUTRON AREA MONITOR FOR THE POSITIVE ION VAN DE GRAAFF GENERATOR FACILITY. Sheen, E. M.; Ratcliffe, C. A. (Battelle-Northwest, Richland, Wash.).

Instrumentation to be used with a moderated neutron proportional counter as an area monitor for the PNL positive ion Van de Graaff accelerator is described. The monitor comprises an adjustable high-voltage power supply, a count rate meter readout, and an alarm with adjustable threshold. The alarm consists of blinking lights and a pulsed acoustic annunciator. (auth)

47316 (CEA-R-3438) USE OF WELL-TYPE IONIZATION CHAMBERS IN RADIOACTIVE METROLOGY. Dalmazzone, Jean; Guiho, Jean-Paul (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1968. 37p. (In French). Dep.

A summary is given of the results of observations and experiments gathered over a period of 10 years in the Radioelement Measurements Laboratory concerning the use of well-type chambers in refined metrology. The optimum conditions for obtaining good reproducibility are defined. This is indispensible if improved sensitivity and accuracy are required. The effects of the nature and the shape of the sources and of the containers, the random form of the response and its statistical treatment, and the nonlinearity and the show drift of the installation, are considered. A sound knowledge of the causes of error, the application of adequate correction methods and an exact calculation of the error, all make it possible to carry out measurements under the best conditions for obtaining a good reproducibility. The accuracy can attain 1.5 per cent. (auth)

47317 (CEA-R-3511) DETECTION OF FISSION PRODUCTS IN CARBON DIOXIDE BY INSTANTANEOUS ION COLLECTION. Le Meur, Roger; Lorin, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr. 1968. 33p. (In French). Dep.

This report describes a fission product detector with instantaneous electric collection, capable of analyzing carbon dioxide up to a pressure of 60 bars and at a temperature of 200°C. In contrast to delayed collection detectors, this apparatus makes it possible to collect rubidium and cesium ions as soon as they are formed; this avoids losses due to recombination. The detector has been tested with a fission product source made up of a uranium oxide sample subjected to a neutron flux. The activity of the ions collected as a function of an electric field has been measured for different parameters: pressure, temperature, CO_2 gas flow rate, and the volume of the ion-formation chamber. The sensitivity of this apparatus is compared to that of other fission product detectors. For a low volume-flow rate, e.g., 100 cm^3 sec^{-1}, its sensitivity for krypton 88 is better than that of a delayed collection detector. An apparatus of this type could be used as a can rupture detector on a reactor with a large number of channels, with a low gas sampling rate per channel. The equipment will be included in the can rupture detector installations in the FESSENHEIM reactor. (auth)

47318 (EURFNR-527) AN ANALYSIS OF TWENTY FOUR ISOTOPES FOR USE IN MULTIPLE FOIL (SANDWICH) MEASUREMENTS OF NEUTRON SPECTRA BELOW 10 keV. RECOMMENDED RESOLVED AND STATISTICAL RESONANCE PARAMETERS FOR TWENTY FOUR ISOTOPES. Connolly, T. J.; de Kruijf, F.; Schmidt, J. J. (Kernforschungszentrum, Karlsruhe (West Germany)). Apr. 1968. 147p. (KFK-718; EUR-3716). Dep.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The results of an analytical investigation of the characteristics of various isotopes for use as sandwich foil detectors in various spectra are presented. The predicted magnitudes of the activation differences between designated foils of a sandwich are given, together with the contributions to the activation difference from one or more individual resonances. Doppler-broadened capture resonance integrals are tabulated by resonance for several isotopes; recommended resolved and statistical resonance parameters for 24 isotopes are also listed. (D.C.W.)

47319 (JAERI-1163) ONE-DIMENSIONAL DIFFUSION EQUATION CODE PMC FOR CYLINDRICAL NEUTRON DETECTORS WITH A MODERATOR. Ryufuku, Hiroshi (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Apr. 1968. 22p. (In Japanese). Dep.

The code PMC can be used to calculate the sensitivities of cylindrical neutron detectors with a moderator. The numbers of energy-groups and regions can be put up to 18 and 5, respectively. Source terms need not be introduced as input data, because they are calculated in the code. Group constants are derived from group-averaged (microscopic) cross sections in one of the subroutines, and therefore, if the latter are prepared on a tape before the use of the code, only a few of the parameters may be input to it. If desired, punched cards are obtained as one of the output data, which can be used as an input deck to the S_N-code. (auth)

47320 (LA-DC-9709) SEMICONDUCTOR DETECTORS FOR USE IN THE CURRENT MODE. Moat, A.; Piper, D. G. (Atomic Weapons Research Establishment, Aldermaston (England); Silbert, M. G. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 10p. (CONF-680915-1). Dep. CFSTI.

From Meeting on Solid State Devices, Manchester, England.

Detectors for neutron cross section measurements using an underground nuclear explosion as the neutron source are discussed. Early tests of commercially available detectors, using proton beams from a 3-MeV Van de Graaff showed that some diffused junction units were satisfactory, but the rather thick window introduced error in fission fragment measurement. Commercial diffused junction units have since become available with much thinner windows, and also surface barrier detectors having good transient response have been developed. The manufacture of these surface barrier units is described, together with the test procedure. Measured rise times are found to agree with predictions. The field distribution within a detector is a function of bias, resistivity, thickness, and the current being passed. A few calculated distributions are shown. (auth)

47321 (RD/B/N-1108) THE CADMIUM SULPHIDE HIGH-LEVEL GAMMA EXPOSURE-RATE METER, TYPE BP4. Hudd, W. H. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). July 1968. 34p. Dep. CFSTI. UK.

A high level (1 to 5×10^4 R/hr) gamma exposure rate instrument using a cadmium sulphide crystal detector was developed. The detector is small and may be mounted either on a telescopic arm attached to the instrument or on a long connecting lead for monitoring otherwise inaccessible areas; it may be used over the temperature range 0 to 60°C. The detector characteristics were investigated in detail and the optimum operating conditions determined. Exposure rate is displayed on a logarithmic scale on a circscale meter. The use of cadmium sulphide crystals outside the quoted ranges of exposure rates and temperatures was also investigated. (auth)

47322 (UUIP-597) DIODE CHARACTERISTICS OF HIGH RESISTIVITY SURFACE BARRIER SILICON DIODES. Tove, P. A.; Madakbas, M.; Seibt, W.; Leitz, W. (Uppsala Univ. (Sweden). Inst. of Physics). Mar. 1968. 31p. Dep.

The current-voltage characteristics of high resistivity silicon surface barrier diodes have been measured and correlated with expected behavior. The resistivity of the n-type silicon ranged from 500 Ωcm to 20 kΩcm, and different evaporated metals for the rectifying and ohmic contacts were investigated. The function of a single contact is discussed in terms of current components of different origin, such as Schottky current, bulk and surface generation-recombination current, diffusion current, and current arising at the edge regions. It is shown that for metals that tend to give high barriers, such as Au and Sb in the back region the voltage-dependent currents from surface generation are moderately pronounced. For metals that tend to give more or less ohmic contacts such as Al, Mn, and In the Schottky component predominates and the corresponding Schottky saturation current becomes higher for metals with low work functions. The barrier height and hence the saturation current is also influenced by the time the chemically prepared surface is allowed to oxidize in air before contact evaporation. A shorter time gives higher saturation current (lower barrier). In cases where the Schottky current predominates, the diode equation is obeyed over a large measured voltage region. The influence of various phenomena such as interface effects, on the forward characteristics is discussed. The characteristics of the complete diode with different front and back contacts is discussed in terms of the properties of the individual contacts. (auth)

47323 THE POSSIBILITY OF REGISTRATION OF LOW β-ACTIVITIES. Karadzhov, A.; Vasilev, G. Fiz. Mat. Spis., Bulg. Akad. Nauk, 11: No. 1, 40-55(1968). (In Bulgarian).

A comprehensive comparative survey of low background, low intensity β-activities, based on 48 references, has been given. The authors describe the external and internal sources of background pulses, method for the suppression of influences due to external and internal background pulses, methods for the increase of the counting efficiency, and the various experimental setups (gas-filled detector without active shield, other gas-filled anticoincidence counters, scintillation shield-equipped detectors, scintillation devices without active shields, scintillation devices with active shield made of gas-filled counter, and scintillation devices with thin β-scintillators). Tables comparing various parameters and properties of different low β-activity counters are also given. (JPRS)

47324 METHOD OF CONTROLLING A REACTOR. Kojima, Shigeyoshi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-4911. Feb. 22, 1968. Filed June 18, 1965.

A method is proposed whereby the instrumentation control in the power range from startup can be done very accurately. And further, because both the γ-ray ionization current due to nuclear fission and the neutron ionization current are measured simultaneously with a single device, the reactor operation from startup can be performed in a safe manner. With a (γ-ray) compensation chamber, the ionization currents of the neutrons and the γ-rays are measured. For the ionization current due to the residual gamma-rays before the start-up, the suppression current is equated by means of an external compensation circuit, including a current adjuster between the positive and negative polarities of two power sources. The reactor is controlled by drawing out a γ-ray ionization current equivalent to the reactor power by the compensation circuit and obtaining the amount of change in the ionization current and its average square root. At higher powers, it is controlled by detecting the neutron ionization current by the same ion chamber. (NSA of Japan)

47325 IMPROVEMENTS RELATING TO PROBES FOR MEASURING RADIOACTIVITY. (to Daimler-Benz Aktiengesellschaft). British Patent 1,127,020. Sept. 11, 1968. Priority date Oct. 16, 1965, Germany.

A telescopic probe for measuring radioactivity is described. It consists of a tubular jacket containing a radiation detector and a retractable telescopic tube. It can be mounted in a motor vehicle to monitor externally and thus protect the operator from radioactive dust. (W.H.K.)

47326 STABILIZED HIGH VOLTAGE SUPPLY UNIT. Lyden, Anders Gustaf; Holmqvist, Yngve Per (to Aktiebolaget Atomenergi). British Patent 1,126,081. Sept. 5, 1968. Priority date Feb. 19, 1965, Sweden.

A stabilized high-voltage power supply for ionization chambers operating in the proportional region is described. The voltage regulator is composed of emitter-follower transistors of like conductivity. (W.H.K.)

47327 GAMMA CAMERAS: ADVANTAGES AND DISADVANTAGES. Webster, Edward W. (Massachusetts General Hospital, Boston). Lahey Clin. Found. Bull., 17: 67-76(Jan.-Mar. 1968).

The attributes of 3 types of gamma cameras are reviewed and their performance is related to certain fundamental concepts. These include the Anger camera, the autofluoroscope, and the magnacamera which uses an x-ray image intensifier. The Anger camera NaI crystal has a 90% efficiency for ^{99m}Tc, while the 1½-in. autofluoroscope crystal is essentially 100% efficient. For ^{203}Hg with 280 keV photons, the Anger camera is 45% efficient while the autofluoroscope is 80% efficient. For ^{131}I the Anger camera is 30% efficient while the autofluoroscope is 70% efficient. The efficiency of the autofluoroscope is reduced at higher energies. In comparison, the 2-mm thick input phosphor of the magnacamera is only highly efficient for photons with energy below 100 keV; for ^{99m}Tc it is ~40% efficient, and for ^{203}Hg and ^{131}I it is less than 10% efficient. Only with very large quantities of radioactivity and therefore with nuclides of very short effective half-life does the statistical resolution become so high as to be demanding of the inherent resolution of the camera and the resolution imposed by the collimation system. The structures of the cameras, statistical resolution capacities, and factors that affect recording speed in cameras and scanners are described and evaluated. (BBB)

47328 PRODUCTION OF p-i-n β COUNTER DIODES FROM SILICON USING THE LITHIUM ION DRIFT METHOD. Braun, Herwig. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 175: 416-35(1966). (In German).

A preparation method for β counter diodes of silicon by the lithium-ion-drift method was developed and the necessary apparatus was constructed. The method is especially suitable for laboratory use since the apparatus cost is comparatively small. The principal steps of the process are as follows. The inlet window consisted of a thin highly boron-doped layer against which the i-zone was coated during the drift process; the boron doping was produced by a paint-on diffusion method. The lithium diffusion was also produced by a paint-on method. The drift process occurred in air at approximately 120°C with a maximum power of 1.5 V/cm^2 at constant drift current. I-zones up to 2 mm thickness were prepared. The best resolution of the first detectors (after subtraction of the noise of the electronic apparatus) was 23 keV (fwhm) at 195°K for ^{137}Cs conversion electrons (625 keV). (tr-auth)

47329 "SEALED" ^{3}He GAS SCINTILLATION COUNTER. Baldin, S. A.; Makarov, Yu. A.; Sokolov, A. D.; Shuvalov, G. I. (All-Union Instrumentation Research Center, Moscow). Prib. Tekh. Eksp., No. 5, 161-4(Sept.-Oct. 1967). (In Russian).

Two variants for the design of a helium-3 gas scintillation counter are described, with their basic parameters. The counter features time-invariant light yield, compact format, and does not require special facilities to ensure a stable response. Results of

tests over a 1.5 year period are reported. The energy distributions of neutrons in work with a spectrometer in which this counter was used as the particle detector are reported. The dose-rate equivalent calculated from different spectra is compared to the results of measurements taken with familiar neutron dosimeters. (auth)

47330 IONIZATION CHAMBER AS A RESONANT γ-EMISSION DETECTOR. Bonchev, Tsv.; Burin, Kl.; Burkov, L. (Sofia Univ.). Prib. Tekh. Eksp., No. 5, 148-9(Sept.-Oct. 1967). (In Russian).

Descriptions are given of the design and performance of a recoilless ionization chamber used to detect the Moessbauer effect. The detector was designed for recording 23.8 keV resonant γ quanta emitted by ^{119m}Sn. A cylindrically shaped chamber with an external electrode diameter of 30 mm and an internal diameter of 0.5 mm has a Teflon insulation between electrodes and mica plates coated with 85% ^{119}Sn-enriched SnO_2 placed inside the chamber. The distance between the plates is 3 mm. Construction of a chamber for 14.3 keV resonance emission from ^{57}Co using $K_4Fe(CN)_6 \cdot 3\ H_2O$ unenriched by ^{57}Fe was investigated. (R.V.J.)

47331 STABILIZATION OF A PHOTOMULTIPLIER IN THE AVERAGE-CURRENT MODE OF OPERATION. Tuktarov, N. S. (Central Design and Planning Office of the Ministry of Wood Industry, Alma-Ata, USSR). Prib. Tekh. Eksp., No. 5, 216-17 (Sept.-Oct. 1967). (In Russian).

It is shown that in the general case photomultiplier (PhM) stabilizers with a finite transconductance of the characteristic do not ensure a constant PhM gain, and that this purpose can be achieved with the aid of servo-type circuits. A practical servo-type circuit is described that ensures PhM stabilization under considerable parameter fluctuations. (auth)

47332 SEMICONDUCTOR DETECTORS: EVOLUTION PERFORMANCE, FUTURE OUTLOOK. Coche, A. (Centre de Recherches Nucleaires, Strasbourg). Nucleus (Paris), 9: 114-21(1968). (In French).

After reviewing the various types of detectors and the performance they actually attain, the problems presented in the realization of use of these counters are set forth. Such problems discussed are the detection of heavy particles using n-p junction surface barrier counters, and the detection of gamma rays using Ge–Li counters. The future prospects for their development are also considered. (J.F.P.)

47333 PERFORMANCE OF HALOGEN COUNTERS AND SOME POINTS ON THEIR OPERATION. Dmitriev, A. B.; Filatov, A. I.; Eig, L. S. Prib. Tekh. Eksp., No. 5, 157-61 (Sept.-Oct. 1967). (In Russian).

The gas-discharge mechanism in halogen-quenched ionization chambers is discussed. It is seen that counting characteristics, charge developed per pulse, dead time and recovery time of halogen-quenched counters are determined by the parameters of the circuitry. The conditions for limiting the active stage of the discharge in halogen-quenched counters are described. (W.H.K.)

47334 SENSITIVE DETECTOR FOR SLOW NEUTRONS. Vasil'ev, S. N.; Kazanskaya, V. A.; Makarov, Yu. A.; Sokolov, A. D. (Union Scientific-Research Inst. for Instrument Making, Moscow). Prib. Tekh. Eksp., No. 5, 165-7(Sept.-Oct. 1967). (In Russian).

A scintillation detector is described, which is efficient in intense γ fields (up to 1 mR/sec). The detector element employs a dispersed system with lithium fluoride and zinc sulfide. Data are presented corresponding to the selection of an optimum relationship between the components of the fluorescent substance, its concentration in the detector, and the size of the grains. An electronic circuit is considered for the detector, to allow pulses brought about from the registration of neutrons to be distinguished from those due to γ quanta. Introduction of the circuit permits the registration sensitivity to be raised by a factor of 1.5-2 in comparison with that obtained in the usual method of amplitude discrimination. (auth)

47335 CONVERSION EFFICIENCY OF CsI(Tl) SINGLE CRYSTALS. Averina, L. I.; Zakharin, Ya. A.; Tsirlin, Yu. A. (All-Union Single Crystals Research Inst., Kharkov). Prib. Tekh. Eksp., No. 5, 168-9(Sept.-Oct. 1967). (In Russian).

Results are reported for the conversion efficiency η (72%) of CsI(Tl) relative to NaI(Tl), as corrected for the integration time and spectral response of the FEU-49 photomultiplier (PM). (auth)

47336 PREAMPLIFIER FOR GERMANIUM DETECTORS HAVING A LOW CAPACITY. Rodionov, K. G.; Ren, Li Sam (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 5, 175-7(Sept.-Oct. 1967). (In Russian).

The noise of a detector-amplifier system depends on both the leakage current and the capacity of the detector, as well as on the amplifier parameters. For detectors having low capacitances the preamplifier tube should be chosen according to the input capacity and mutual conductance. A preamplifier is described using type 6N23P tubes (C_{in} = 3.2 pF) which has an rms noise of 1.9 keV with C_{ext} = 0. (auth)

47337 PARTICLE IDENTIFICATION USING A CATHODE-RAY TUBE AND MASK. Al'-Dzhauakhiri, A. U.; Zazulin, V. S.; Kostyuchenkov, S. D.; Spasskii, A. V.; Teplov, I. B. (Moscow State Univ.). Prib. Tekh. Eksp., No. 5, 142-6(Sept.-Oct. 1967). (In Russian).

A two-counter telescope and its associated electronics intended for the separation of protons, deuterons, and tritons produced in nuclear reactions are described. (auth)

47338 RADIATION DETECTING APPARATUS WITH SELF-CHECK. Garfunkel, James H.; Spence, Gary W. (to Honeywell Inc.). U. S. Patent 3,396,386. Aug. 6, 1968. Filed Nov. 8, 1965.

A Geiger tube fault circuit is described. The Geiger tube has a first and a second output, the first output responding to frequent counting of the Geiger tube to indicate the presence of radiation, and the second output responding to the absence of background counting of the Geiger tube to indicate that the Geiger tube has failed. (auth)

47339 CHARGED PARTICLE DETECTOR WITH LITHIUM COMPENSATED INTRINSIC SILICON AS AN INTERMEDIATE REGION. Chow, Ken-tang (to Electro-Nuclear Labs., Inc.). U. S. Patent 3,396,318. Aug. 6, 1968. Filed May 16, 1963.

A high resolution charged particle detector is made from a reverse biased semiconductive wafer of lithium compensated intrinsic silicon by providing an n-type region at one surface and at an opposite surface, a shallow p-type region underlying a thin window for charged particle impingement. (auth)

47340 PROPORTIONAL COUNTER TUBE HAVING A PLURALITY OF INTERCONNECTED IONIZATION CHAMBERS. Bowyer, Charles S. (to Secretary of the Navy). U. S. Patent 3,396,300. Aug. 6, 1968. Filed Dec. 30, 1965.

A proportional counter suitable for detecting x radiation in a range of from about 1 to about 8 angstrom units is described. The device includes a single housing within which a plurality of anode sections are assembled. A honeycomb collimator provides 10 degree total collimation for incident radiation and a single window covers all of the anode sections. (auth)

47341 IONIZATION TYPE RADIATION DETECTOR. Martin, Philip T.; Tompos, Donald J. (to Industrial Nucleonics Corp.). U. S. Patent 3,396,275. Aug. 6, 1968. Filed Aug. 24, 1964.

An ionization chamber designed for improved temperature stability is described. The chamber includes a metallic housing and voltage electrodes consisting of circular plates. The same potential is applied to the voltage electrodes and the housing. An ionizable gas is sealed in the housing. A signal electrode, also a circular plate, is disposed between the voltage electrodes, and is at a different potential. The electric field at the end of the voltage and signal electrodes, adjacent to the housing, is maintained high, by a lip about the circumference of the voltage electrodes that embraces the end of the signal electrode. (auth)

47342 SOLID-STATE TRACK DETECTORS. Monnin, Michel (Faculte des Sciences, Clermont-Ferrand, France). Radioprotection, 2: 105-17(1967). (In French).

A general survey of characteristics of solid-state nuclear track detectors is presented. Organic detectors (polymeric systems) are emphasized. The development of ionizing particles tracks by chemical etching is described. The chemical etching reagents to be used with new detectors such as polyethylene, polypropylene and ionomeric polyethylene and, also, new methods to reveal some already known detectors are given. Then, the most important characteristic of detectors, i.e., its very sharp detection cut-off is explained and a suggestion to give a different definition of the detection threshold is given. Finally, possible mechanics for track formation are briefly discussed. (auth)

47343 SOLID DIELECTRICS AS DETECTORS FOR CHARGED PARTICLES. Jodogne, J. C. (Univ., Louvain, Belg.). Rev. Quest. Sci., 139: 191-206(Apr. 1968). (In French).

Bombardment of charged heavy particles results, for many insulators, in a sufficient number of ionizations to permit preferential chemical attack along the length of the trajectory. These tracks are stable and observable with a microscope. Such detectors are insensitive to neutrons, electrons, protons, and γ rays. The use of the electron microscope provides a method for the study of tracks of particles with extremely short lifetimes. Samples of the lunar surface may be studied by this technique to give information not only about the history of the moon, but also about the nature of primary heavy cosmic rays. Development of a technique for atomic number determination of the particles is described. Photographs illustrate the development of tracks. (BBB)

47344 POSSIBILITIES OF THE USE OF SEMICONDUCTOR DETECTORS OF IONIZING RADIATION IN RADIOBIOLOGY AND

MEDICINE. Petushkov, A. A. (Inst. of Occupational Hygiene and Diseases, Moscow). Radiobiologiya, 8: 135-41(1968). (In Russian).

A survey of the literature (31 references, 1949 to 1966) on applications of semiconductor detectors of ionizing radiation in radiobiology and medicine is presented. The most suitable were found to be those based on silicon and germanium with p-n and p-i-n junctions (small dimensions, high energy resolution, low power consumption). (JPRS)

47345 RESULTS OF A STUDY OF OVERFILLED S15G COUNTERS DESIGNED TO OPERATE IN THE PROPORTIONAL REGION. Blokh, Ya. L.; Dmitriev, A. B.; Eroshenko, E. A.; Leonov, V. Kh. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 113-15(1968).

Translated from Geomagn. Aeron., 8: 143-5(1968).

A plateau of the proportional region of 200 V was obtained for S15G counters overfilled with cyclohexane. The differential spectra and count characteristics of the overfilled counters are described and the circuit of the shaping cascade with a current amplifier is presented. The advantages of the new counters over the S15G and their possible practical applications are examined. (auth)

47346 ABSOLUTE FISSION RATE MEASUREMENTS WITH SOLID-STATE TRACK RECORDERS. Gold, Raymond (Argonne National Lab., Ill.); Armani, Roland J.; Roberts, James H. Nucl. Sci. Eng., 34: 13-32(Oct. 1968).

The method of fission track counting has been placed on a precise absolute basis. Sources of systematic error were investigated and eliminated or reduced so that precise fission rate measurements can be conducted. Solid-state track recorders of pre-etched mica and polycarbonate resin (Makrofol) were used. Experimental results depend critically on the quality of the fission sources employed. Consequently, different methods of fission source preparation were examined. The efficiency and sensitivity of this method were determined for both mica and Makrofol. An irradiation assembly providing uniform neutron flux exposures was used for relative measurements. Absolute calibrations were carried out with ^{244}Cm spontaneous fission sources. A limiting accuracy of close to 1% for absolute uranium fission rate measurements was achieved. (auth)

47347 PROCEDURE FOR DETERMINING THE PARAMETERS FROM A FISSION FRAGMENT ENERGY SPECTRUM. Long, A. B.; Wehring, B. W.; Wyman, M. E. (Univ. of Illinois, Urbana). Rev. Sci. Instrum., 39: 1566-8(Oct. 1968).

A silicon surface-barrier detector may be evaluated by determining certain parameters from a fission fragment energy spectrum recorded by that detector. The computer program ANLZE which determines these spectrum parameters in a consistent manner by using a combination of smoothing and fitting routines in the analysis of the data is described. The effect of the statistical uncertainty of the data on the values of the parameters determined by the program is discussed for various fitting procedures. (auth)

47348 SPLASH PROTECTION OF A LARGE AREA RADIATION DETECTOR VIEWING A WATER SURFACE. Quirk, E. J. M. (AB Atomenergi, Studsvik, Sweden). Rev. Sci. Instrum., 39: 1585-8(Oct. 1968).

A protective film and heater assembly, designed to afford splash protection to a large area detector for monitoring water surfaces, is described. (W.H.K.)

47349 SILVER COUNTER FOR BURSTS OF NEUTRONS. Lanter, Robert J.; Bannerman, Daniel E. (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instrum., 39: 1588-9(Oct. 1968).

A silver activation counter is described which is used to measure the number of neutrons produced in a single burst that has a duration of the order of a few microseconds or a series of short bursts. The counter consists of a moderator, Geiger tubes, silver foils, and associated electronic equipment. A brief description of the counter and its calibration is given. (W.H.K.)

47350 POSITION DETECTOR FOR CHARGED PARTICLE BEAM. Fuketa, Toyojiro; Takekoshi, Hidekuni (Japan Atomic Energy Research Inst., Tokyo). Rev. Sci. Instrum., 39: 1573 (Oct. 1968).

A multiwire ionization-type detector is described which detects the position of charged particle beams. (W.H.K.)

47351 NEW TYPE OF POSITION-SENSITIVE DETECTORS OF IONIZING RADIATION USING RISETIME MEASUREMENT. Borkowski, C. J.; Kopp, M. K. (Oak Ridge National Lab., Tenn.). Rev. Sci. Instrum., 39: 1515-22(Oct. 1968).

A new method was developed for determining the position of ionizing events by measuring the risetime of output pulses from detectors having high resistance collectors. Several prototype detectors, such as proportional counters, pulse ion chambers, and surface barrier detectors, were constructed and tested for this purpose. These detectors were treated as infinite RC lines with distributed parameters, and the position-dependent risetime of the output pulses was measured by crossover timing after double RC differentiation. With these detectors the impact locations of x rays, thermal neutrons, and alpha particles were determined. The spatial uncertainty obtained with 400 mm long proportional counters was 0.5 mm FWHM, for 22 keV x rays, 6 mm FWHM for thermal neutrons, and 0.66 mm FWHM for ^{242}Cm alpha particles. A spatial uncertainty of 1.25 mm FWHM was obtained with a pulse ion chamber for ^{242}Cm alpha particles. This method of determining the position of an ionizing event gives good linearity and spatial resolution with relatively simple electronic circuitry. (auth)

47352 GAMMA RADIATION SENSOR AND DETECTION SYSTEM. Carrell, Terry E. (to North American Rockwell Corp.). U. S. Patent 3,399,302. Aug. 27, 1968. Filed June 19, 1964.

A gamma-ray scintillation detector system is described for detecting the presence of fissionable materials over long distances. The system is primarily designed to detect the presence of undetonated nuclear weapons. (W.H.K.)

47353 AUTOMATIC INTERVAL SETTING MEANS IN TIMING DEVICE FOR COUNTING NUCLEAR DISINTEGRATIONS. Dietrich, Jacob Edwin (to Ambco Electronics). U. S. Patent 3,395,280. July 30, 1968. Filed Oct. 23, 1964.

A timer with automatic setting of the time interval is described. It comprises means for counting a predetermined number of events, means for automatically setting the time interval of the timer to the time which was required to count such predetermined number of events, and means for counting the number of events occurring in said set interval during subsequent counting cycles, thereby providing for comparison of unknown samples with the known sample used in initially setting the time interval. The counter automatically counts the pulses from a second sample for the same period of time that it counted a predetermined number of pulses from a first sample. (auth)

47354 IMPROVEMENTS IN OR RELATING TO NUCLEAR PARTICLE DISCRIMINATORS. Kandiah, Kathirkamathamby (to United Kingdom Atomic Energy Authority). British Patent 1,128,328. Sept. 25, 1968. Filed Dec. 21, 1964.

Design of a pulse discriminator for use with a scintillation detector is presented. The fast integrated pulse and the total integrated pulse are compared for particle discrimination. (W.H.K.)

47355 SCINTILLATION DETECTORS. (to Philips Electronic and Associated Industries Ltd.). British Patent 1,121,986. July 31, 1968. Priority date Feb. 3, 1966, United States.

The design of a gallium arsenide detector in conjunction with a semiconductor phototube for detecting x rays and nuclear radiations is presented. (W.H.K.)

47356 SOME STORAGE INVESTIGATIONS ON TOLUENE BLENDED AND DIOXANE LIQUID SCINTILLATION MIXES. White, David R.; Gwyther, M. M. (Royal Marsden Hospital, Sutton, Eng.). Bio-Med. Eng., 3: 208-10; 214(May 1968).

The results of long-term storage investigations carried out on a series of liquid scintillation mixes for aqueous samples derived for tritiated water are presented. Tests were conducted to derive a reliable gassing technique to remove atmospheric oxygen which is a quenching agent. Its removal results in higher counting efficiencies. Efficiency changes in a toluene blended mix containing water volumes in excess of the recommended blended volume were studied. Changes in efficiency of ungassed and gassed samples, stored at 5°C to determine whether storage of samples before use affects the observed sensitivity, were measured. Efficiency changes in ungassed and gassed samples prepared from mixes stored under air, in the dark, and at room temperature were measured. The test was designed to determine whether mixes prepared in bulk and stored can be used for absolute measurements. (BBB)

47357 FUNDAMENTALS OF CALCULATION OF ERROR STATISTICS IN NUCLEAR RADIATION MEASUREMENT TECHNIQUE. PART VI. Weise, Lothar (Kernforschungsanlage, Juelich, Ger.). Arch. Tech. Messen., No. 383, 267-72(Dec. 1967). (In German).

The testing of statistical hypotheses in measurement of nuclear radiation is discussed. Factors such as measurement equipment error or random error may affect measurements of Poisson distribution or differences between pulse rates from two sources. Formulation of test theory from concepts of sample space, observation vectors, critical area, assumption area, error limits, etc., is described. Alternatives of optimal statistical tests are discussed. Criteria for classification of test data, for numbers

of samplings to be made, and for test design are suggested. Application of the test procedures to a specific problem in α-particle counting is given in detail. (BBB)

47358 TOLUENE BLENDED MIXES FOR AQUEOUS TRITIUM SAMPLES. White, David R. (Royal Marsden Hospital, Sutton, Eng.). Bio-Med. Eng., 3: 76-9(Feb. 1968).

The significant counting characteristics of 11 popular blending agents used for liquid scintillation counting of ^3H are described and discussed. A basic toluene mix of 4 g PPO/l and 300 mg dimethyl POPOP/l was established for the nonquenching tritiated hexadecane. The water-miscible agents were added (0 to 1000 ml/l toluene) and the count rates measured for 1 μCi ^3H_2O in volumes of 0.1, 0.2 and 0.4 ml in 10 ml scintillator. The agents included butoxyethanol, dioxane, ethanol, 50 : 50 ethanol/dioxane, 25 : 75 ethanol/dioxane, 75 : 25 ethanol/dioxane, ethoxyethanol, isobutyl alcohol, isopropyl alcohol, methanol, and methoxyethanol. Changes in the counting efficiency as a function of blending concentration and solute concentration were measured and compared. Ethoxyethanol, isopropyl alcohol, ethanol, and the ethanol/dioxane mixtures gave the greatest over-all counting efficiencies. (BBB)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 47329, 47382, 48394, 48413, 48507, and 48509.

47359 (CALT-68-153) CALIBRATION OF THE 1200 MeV/c AND 1670 MeV/c MAGNET CONFIGURATIONS. Report No. 36. Wolverton, F. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Mar. 5, 1968. Contract AT(11-1)-68. 50p. Dep. CFSTI.

The measurement of the focusing and acceptance properties and centrol momentum calibration of a magnetic proton spectrometer are described. The spectrometer will measure the momenta of protons up to 1670 MeV/c. (W.H.K.)

47360 (IITRI-578-P-31-2) DEVELOPMENT OF NEUTRON SPECTROMETRY FOR CRITICAL ASSEMBLIES. Final Report. Moler, R. B.; Zagotta, W. E. (IIT Research Inst., Chicago, Ill.). Aug. 1968. Contract AT(11-1)-578. 95p. Dep. CFSTI.

The design, construction, and preliminary testing of two neutron spectrometer concepts are discussed. One spectrometer, based on the proton recoil technique and intended for in-core measurements in nuclear reactor critical assemblies, incorporates an annular ring of proportional counters surrounding a wall-less central counter. By operating the ring counters in anticoincidence with the central counter, the gamma sensitivity is reduced by as much as a factor of 100 without any significant effect on the neutron sensitivity (for neutron energies less than about 100 keV). The other spectrometer is a ^3He-sandwiched spectrometer which uses the ^3He converter gas as the filling gas for two identical wall-less proportional counters. This spectrometer is relatively insensitive to gamma rays, compensates for the reaction energy lost in the converter material, and discards pulses produced by the neutron-induced interfering reactions which occur in the silicon solid-state detectors and in the ^3He. (auth)

47361 (ORNL-tr-1971) THE SIGNAL-NOISE RATIO OF A TIME-DEPENDENT FILTER FOR IMPROVEMENT OF THE ENERGY RESOLUTION IN NUCLEAR RADIATION SPECTROSCOPY WITH SEMICONDUCTOR DETECTORS. Weise, K. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Nucl. Instrum. Methods, 61: 241-4(1968). 7p. Dep. CFSTI.

The signal-to-noise ratio of a time-dependent filter proposed by Schuster for improving the energy resolution in nuclear spectroscopy with semiconductor detectors is calculated and found to be only 3.7% below the value of the optimum filter and better than the signal-to-noise ratios of other filters, especially 31% greater than that of the RC-integration-RC-differentiation-filter commonly used. (auth)

47362 USE OF A PDP-9 FOR REAL TIME OFF LINE ANALYSIS OF SPECTRA FROM AN AERIAL SURVEY FOR RADIOACTIVE MINERALS. Thompson, C. J. (Atomic Energy of Canada Ltd., Ottawa). pp 177-86 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

A PDP-9 is being used to process data in real time from an airborne gamma ray spectrometer being used to detect deposits of radioactive minerals. A pulse height-to-width converter in the helicopter records pulse widths proportional to gamma ray energies on magnetic tape. The pulse widths are digitized into 1024 channels by an interface to the PDP-9. A program examines the spectrum as a function of real time and records the ratios of the counts due to uranium, thorium, and natural potassium. The updated results are displayed using an interface designed to make full use of a variable persistence oscilloscope. (auth)

47363 GAMMA-RAY SPECTRUM STRIPPING. Riess, F. (Stanford Univ., Calif.). pp 159-62 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

A FORTRAN program is described which analyzes multichannel pulse-height spectra of gamma rays by a least-squares fitting method. Up to five gamma ray lines can be analyzed simultaneously. A background of arbitrary shape can be included in the fit. (auth)

47364 TAPE RECORDER I/O OPERATION IN A PDP-8 CONTROLLED BETA-RAY SPECTROMETER SYSTEM. Park, J. J. H.; Ohkuma, J. (National Research Council, Ottawa). pp 113-26 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

A simple high speed I/O system, utilizing an inexpensive tape recorder, which has been developed for use in conjunction with PDP-8 or PDP-8/S machines is described. The I/O speed of up to 500 (12 bit) words per second has been achieved on PDP-8 and about 250 on PDP-8/S. With the I/O routines modified, the symbolic tape editor and PAL III assembler are being used extensively in this system. (auth)

47365 AMPLIFIER WITH AUTOMATIC GAIN CONTROL FOR PRECISION AMPLITUDE SPECTROMETERS. Mel'nikov, G. P.; Somikov, A. V. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 5, 171-4(Sept.-Oct. 1967). (In Russian).

Design principles are discussed for a feedback amplifier in which there is an added electronically controlled switching circuit that can vary the gain according to a number supplied to it in binary code form. Both vacuum tube and transistor versions of the amplifier circuits are given which are employed in a stabilizing system for the gain and the discrimination threshold of an amplitude γ spectrometer using a semiconductor transducer. The range of the gain variation in such amplifiers can be made as much as ±50% vs the nominal with several hundred discrete steps of gain provided within these limits. (auth)

47366 MAGNETIC SPECTROMETER FOR ANALYZING CHARGED PARTICLES WITH MOMENTA UP TO 2 GeV/c. Afanas'ev, N. G.; Gol'dshtein, V. A.; Dementii, S. V.; Yaroshevskii, L. D.; Arkatov, I. M. (Physicotechnical Inst., Kharkov). Prib. Tekh. Eksp., No. 5, 146-7(Sept.-Oct. 1967). (In Russian).

A spectrometer of the sector type with an homogeneous field, nearly ideal horizontal focusing, and second-order vertical focusing, allowing for stray fields at the boundaries which has been developed to study physical processes arising under the influence of electron or photon beams at the exit from the LU-2000 linear electron accelerator is described. (auth)

47367 β-SPECTROGRAPH OF THE INSTITUTE OF NUCLEAR RESEARCH OF THE CZECHOSLOVAKIAN ACADEMY OF SCIENCES. Zvol'ska, V.; Kutsarova, T.; Kuklik, A.; Kratsik, B.; Makhachek, Z.; Cherny, M. (Nuclear Research Inst., Rez, Czech.). Prib. Tekh. Eksp., No. 5, 34-7(Sept.-Oct. 1967). (In Russian).

A Danish type, permanent magnet β spectrometer with photographic recording is described. The magnetic field is measured by a nuclear magnetometer. The source and photographic plates are optically positioned. The instrument is intended for a study of high-resolution conversion-electron spectra. (auth)

47368 THIN-WINDOW LITHIUM-DRIFTED DETECTOR FOR SPECTROMETRY OF MEDIUM-ENERGY BETA PARTICLES. Maksimov, Yu. S.; Guseva, M. I. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 5, 150-1(Sept.-Oct. 1967). (In Russian).

A short review of the theory and the fabrication of lithium-drifted silicon detectors for beta spectroscopy is presented. (W.H.K.)

47369 SOME EXPERIMENTAL SAMPLING RESULTS FOR REGRESSION ANALYSIS APPLIED TO GAMMA-RAY SPECTROMETER DATA. II. Pasternack, Bernard S.; Liuzzi, Anthony (New York Univ. Medical Center, New York). Biometrics, 24: 353-62(June 1968). (TID-24160).

Empirical sampling results are presented which complement those in the 1st report of this series, wherein the results were based on the first 50 channels of pulse-height data only. This was done to minimize the effect of baseline and gain inconsistencies

(essentially changes in the instrument location and scale parameters) which occurred during the sequential counting of the prepared radioactive mixture; such inconsistencies were apparent when the data were analyzed using 120 channels. Here, use was made of a baseline and gain correction procedure recently developed by the authors in the analysis of the same experimentally obtained set of γ-ray spectrometer data. This correction or transformation procedure represents, in effect, a nonlinear modification of the usual weighted least squares regression technique. Application of this transformation-compensation procedure to the 120 experimentally obtained pulse-height distributions (over 120 channels) resulted in effectively removing the previously encountered instrumental instabilities without significantly disturbing the statistical properties of the regression model under consideration. (BBB)

High Energy Physics Instrumentation

Refer also to abstracts 47850 and 48387.

47370 (JINR-P13-4020) WIRE SPARK CHAMBER WITH STATIC MAGNETOSTRICTIVE DELAY-LINE STORE. Bespalova, T. V.; Golutvin, I. A.; Zanevskii, Yu. V.; Kiryushin, Yu. T.; Kondrashov, V. D.; Peshekhonov, V. D.; Ryabtsov, V. D.; Silaev, E. A.; Smolin, D. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1968. 9p. (In Russian). Dep.

A filmless wire spark chamber with static magnetostrictive delay-line store is described. The application of this chamber simplifies an information pick-up and essentially reduces the necessary volume of registration apparatus. The efficiency of coordinate detection in the chamber with static store is no poorer than that in the usual magnetostrictive and ferrite chamber, and the accuracy of coordinate measurement is better. (auth)

47371 (ORO-3065-16) PROGRESS REPORT [ON HIGH-ENERGY PHYSICS], JULY 1, 1967-JUNE 30, 1968. (Duke Univ., Durham, N. C.). Aug. 5, 1968. Contract AT(40-1)-3065. 7p. Dep. CFSTI.

The development of RIPPLE, a semiautomatic measuring device for analyzing bubble chamber particle tracks, is described. Also, the high-energy physics research work at Duke is briefly outlined. (W.H.K.)

47372 (PPAR-3) USE OF A SMALL ON-LINE COMPUTER IN A WIRE SPARK CHAMBER EXPERIMENT. Mischke, R. E.; Metzger, J.; Shepard, P. F.; Devlin, T. J. (Princeton Univ., N. J. Palmer Physical Lab.). May 16, 1968. Contract AT(30-1)-2137. 35p. Dep. CFSTI.

The programming of a small computer used on-line with magnetostrictive wire spark chambers in an experiment to measure the neutron-proton elastic differential cross section for incident neutrons in the range 275 to 1500 MeV is described. (W.H.K.)

47373 (SLAC-PUB-426) AUTOMATIC FILM DIGITIZER PERFORMANCE AND PLANS AT SLAC. Brown, J. (Stanford Linear Accelerator Center, Calif.). July 1968. 16p. (CONF-680628-1). Dep. CFSTI.

From International PEPR Colloquium, Nijmegen, Netherlands.

A description of the hardware and software used in the automatic data analysis of spark chamber pictures at SLAC and a report on the results are presented. Plans for the analysis of bubble chamber pictures are outlined briefly. (auth)

47374 (UCSB-34-P-135-7) LIQUID HYDROGEN AND DEUTERIUM DIFFERENTIAL CHERENKOV COUNTERS. Caldwell, David O.; Elings, Virgil B.; Hesse, William P.; Morrison, Rollin J. (California Univ., Santa Barbara. Dept. of Physics); Ayres, David S.; Cormack, Allan M.; Greenberg, Arthur J.; Kenney, Robert W.; McLaughlin, Edwin F.; Schafer, Richard V. (California Univ., Berkeley. Lawrence Radiation Lab.). July 1968. Contract AT(11-1)-34. 15p. (CONF-680906-3). Dep. CFSTI.

From International Symposium on Nuclear Electronics, Versailles, France.

A liquid hydrogen differential Cherenkov counter was developed to detect 0.3 GeV/c ($\beta = 0.92$) pions for comparing π^+ and π^- lifetimes in a check of CPT invariance. This type of counter, previously reported, has now been improved considerably so that it gives no empty-counter counts, remains clean with no window fogging, and has a very stable index of refraction. Liquid deuterium has also been used successfully as the Cherenkov medium, and a large counter (7-inch diameter) has been made. Both the large and small (4-inch diameter) counters have cleanly separated pions and muons of the same momentum, with a peak-to-valley ratio of about 10^4:1 for particles traversing the counter. (auth)

47375 ARGON-CHERENKOV CELL II (Engineering Materials). (Stanford Univ., Calif. Stanford Linear Accelerator Center). (CAPE-1763).

1 drawing.

Argon-filled Cherenkov cells used for monitoring the electron beam in the beam bending yard and in the target areas of the end stations of the Stanford Linear Accelerator are described. The argon is contained in the inner gas cell which operates slightly above atmospheric gas pressure. The gas cell is built in a tubular hammerhead configuration. The sensitivity of the cell is 3×10^{-10} A/cm^2 with a spot definition of 1 mm and a maximum aperture of 3 in. dia. (For details see TID 4100 Suppl. 47) (See also NSA 21: 17213). (F.S.)

47376 TRACK FOLLOWER: A SYSTEM FOR BUBBLE CHAMBER TRACK RECOGNITION. Taylor, James P. (Massachusetts Inst. of Tech., Cambridge). pp 193-5 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

Track following is a major pattern recognition problem in the automatic scanning of bubble chamber film. The PEPR device controlled by a PDP-6 is described where track following is done in real time. Both the film and the computer are used as storage for track data. Each track is followed one view at a time, and the resulting data must meet certain requirements (e.g., continuity) to be accepted. Pattern recognition problems arise from close lying tracks, and from small angle-crossing tracks. (auth)

47377 EXPANSION DEVICE AND FAST-ACTING VALVE FOR LARGE BUBBLE CHAMBERS. Pershin, I. I.; Golubchikov, V. M.; Konoplev, N. S.; Nikitin, A. A. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 5, 232-4(Sept.-Oct. 1967). (In Russian).

The design and operating characteristics of an expansion system of a bubble chamber, operating by control of the lower level of the pressure drop with reduced gas discharge from the compressor trunk are described. The operating valve of the chamber is pneumatic, two-way, and controlled by two electromagnetic valves. (auth)

47378 FILMLESS SPARK CHAMBER FACILITY OPERATING ON LINE WITH AN ELECTRONIC COMPUTER. Gavrilov, A. S.; Govorun, N. N.; Golutvin, I. A. (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 5, 151-6(Sept.-Oct. 1967). (In Russian).

A facility consisting of nine magnetostrictive delay-line spark chambers, recording instruments, communication line, and an electron computer BESM-3M located within one km from the experiment is described. The facility was constructed and tested using the π^- meson beam in a Dubna synchophasotron. (tr-auth)

47379 MEASUREMENT OF THE RELATIVISITIC INCREASE OF THE SPECIFIC PRIMARY IONIZATION IN A STREAMER CHAMBER. Davidenko, V. A.; Dolgoshein, B. A.; Semenov, V. K.; Somov, S. V. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz., 55: 426-34(Aug. 1968). (In Russian).

The possibility of measuring the specific primary ionization in a streamer chamber is demonstrated. With an accuracy to 2% the increase of the primary ionization is measured in a chamber filled with helium at a pressure of 0.6 atm. (auth)

47380 NORTHWESTERN UNIVERSITY 50 cm LIQUID HELIUM BUBBLE CHAMBER. Walker, R. J.; Block, M. M.; Kenyon, I. R.; Koetke, D.; Keren, J.; Malhotra, P.; Mazur, P.; Winzler, H. (Northwestern Univ., Evanston, Ill.). Rev. Sci. Instrum., 39: 1407-17(Oct. 1968).

The Northwestern University 50-cm liquid helium bubble chamber had its engineering run at the University of Chicago cyclotron in October 1965, after a construction and testing period of just under 2 yr. The chamber dimensions are approximately $50 \times 25 \times 32$ cm, and the water-cooled magnet can provide a field of 30 kG. The chamber and magnet, which weigh about 2.2×10^5 N, can be lifted into a beam site while in operational condition, and the chamber and magnet require a space of only 7.6×4.5 m in the beam line. The expansion is performed by a bellows located above the magnet. A repetition period of 1.2 sec/pulse has been achieved continuously. The optical system uses dark field illumination with three cameras which view the entire chamber with a maximum stereo angle of 16°. The cameras use 35 mm film and have a demagnification of $1/_{12}$. The chamber has produced approximately 10^6 useful photographs in three separate runs, and these pictures are currently being analyzed. (auth)

47381 POLLY I: OPERATOR-ASSISTED BUBBLE CHAMBER FILM MEASURING SYSTEM. Barr, R. G.; Clark, R. K.;

Hodges, D.; Loken, J. G.; Manner, W. E.; Musgrave, B.; Pennock, P. R.; Royston, R. J.; Wehman, R. H. (Argonne National Lab., Ill.). Rev. Sci. Instrum., 39: 1556-62(Oct. 1968).

A new computer-controlled, bubble chamber film measuring device has been designed, constructed, and has been in use since July 1967. It uses a cathode ray tube as the digitizing light source. The unit of measurement is a slice scan which is the flying spot digitization of a small, variable-sized, rectangular area that can be oriented in any one of 32 equally spaced directions around 360°. Facilities are provided for an operator to view the picture currently being measured and to engage in an efficient dialogue with the control computer. Measurement of film is controlled by computer programs and has proceeded at a maximum rate of 60 two-prong events per hour, with the computer requesting operator assistance when required. A coordinate precision of about ±2μ on 70 mm film is attained. (auth)

Radiation Dosimeters

Refer also to abstracts 47154, 47187, 47294, and 48746.

47382 (N-68-24341) STUDY TO DETERMINE THE UTILITY OF SPECTRUM TO DOSE CONVERSION. Final Report. (Ling-Temco-Vought, Inc., Dallas, Tex.). Apr. 30, 1968. Contract NAS9-7565. 34p. (NASA-CR-92104). CFSTI.

It is the purpose of this effort to demonstrate the utility of the pulse height-to-dose conversion system, in conjunction with the beta-gamma spectrometer, as such a system. This effort will also provide a conceptual electronic design of a system utilizing the beta-gamma spectrometer as a real time dosimeter for separate or mixed fields of both electrons and gamma rays. (auth) (STAR)

47383 (TID-24640) ANNUAL PROGRESS REPORT [ON THERMOLUMINESCENCE DOSIMETRY], JULY 15, 1967-AUGUST 31, 1968. Cameron, John R. (Wisconsin Univ., Madison). Contract AT(11-1)-1105. 98p. Dep. CFSTI.

RADIATION DOSIMETERS, THERMOLUMINESCENT — properties of manganese-activated lithium tetraborate; thermoluminescent traps in lithium fluoride, ultraviolet repopulation of; characteristics of dysprosium-activated calcium fluoride; readout system for, evaluation of; use of natural calcium fluoride, for ultraviolet dosimetry

POTASSIUM CHLORIDES — color centers in strontium-activated monocrystal of, Stark effect of Z_1

LITHIUM FLUORIDES — color centers of magnesium-activated monocrystal of, fluorescent lifetime of Z_3

COMPUTER PROGRAMS — for calculating thermoluminescent glow peaks and decay rates, in FORTRAN IV (W.H.K.)

47384 (UR-49-894) MEASURING AVERAGE NEUTRON ENERGIES AND DOSE RATES AROUND A 20-MeV VAN DE GRAAF ACCELERATOR WITH THE MULTI-SPHERE DETECTOR BY THE BLOCK-SHON TECHNIQUE. Gifford, B. R.; Mermagen, H.; Maillie, H. D. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). Jan. 31, 1968. Contract W-7401-eng-49. 54p. (CONF-680607-8). Dep. CFSTI.

From 13th Annual Health Physics Society Meeting, Denver, Colo.

The neutron dosimetry system used at the Rochester 20-MeV tandem Van de Graaff accelerator is described. Various sized Bonner spheres, consisting of polyethylene-moderated europium-activated lithium iodide scintillation detectors, are used for neutron spectroscopy. The Block-Shon technique for measuring average neutron energies and dose-equivalent rates with the multisphere spectrometer system is discussed. Operating characteristics are listed in tabular form and graphically. (W.H.K.)

47385 STUDY OF THE SYSTEM FERROUS SULPHATE-BENZOIC ACID IN THE DOSIMETRY BELOW 100 RADS. Faucitano, Antonio; Martinotti, Fausta Faucitano; Maxia, Vera (Univ., Pavia, Italy). Ric. Sci., 38: 214-20(Mar. 1968). (In Italian).

The effects of various parameters on the sensitivity of the ferrous sulfate-benzoic acid dosimeter were studied. The impurities affect the rate of the radiochemical oxidation of Fe^{2+}. The sensitivity of the dosimeter increases on increasing the concentration of benzoic acid and oxygen and decreasing the concentration of ferrous sulfate and sulfuric acid in the system. A limiting value for the $G(Fe^{3+})$ is obtained at concentrations of benzoic acid and ferrous sulfate equal, respectively, to 2.5×10^{-3} M and 10^{-4} M. At ferrous sulfate concentrations below 10^{-4} M, the dosage curves are not linear. Under the experimental conditions determined the ferrous sulfate-benzoic acid system can be used for the measurement of doses in the range 5 to 100 RADs. (auth)

47386 EFFECTS OF THE MANY-FOLD SCATTERING OF ELECTRONS ON THE IONIZATION IN GAS-FILLED CAVITIES. Harder, Dietrich (Univ., Wuerzburg, Ger.). Biophysik, 5: 157-64(1968). (In German).

If a gas-filled cavity is inserted into an electron-irradiated solid or liquid material, the fluence of electrons within the volume now occupied by the cavity is increased due to the weakness of scattering from the gas. The amount of ionization produced in the gas therefore oversteps the amount corresponding to the undisturbed radiation field that was present prior to the insertion of the cavity. The additional track length of electrons within the cavity and the additional ionization resulting from it are calculated from the theory of small angle multiple scattering. The regularities derived in this way are used to understand the magnitude of the scattering effects observed by other authors and to estimate the experimental errors of gas-filled ionization chambers in electron dosimetry introduced by multiple scattering. (auth)

47387 INSTRUMENT FOR READING IONIZATION CHAMBER DOSIMETERS. Hoitink, Neil C.; Sheen, Edwin M. (Battelle Memorial Inst., Richland, Wash.). Med. Res. Eng., 7: 39-42 (2nd Quarter 1968).

An instrument is described which permits accurate reading of condenser ionization chamber dosimeters. It measures peak voltage developed across a resistor by the charging current. Peak voltage is a measure of the amount of ionizing radiation to which the chamber has been exposed. Measurements of peak voltage are accurate to >±1% and are displayed on digital readout. Actual dose calibration depends on the characteristics of the chamber used. The dynamic range of the instrument covers 3 decades with automatic range selection, which makes it unnecessary to estimate dose prior to measurement. The instrument provides a reasonably simple solution to the problem of accurately measuring the peak voltage amplitude of single pulses that may occur from 10 mV to 10 V, without requiring that the approximate size of the pulse be determined prior to the measurement. The method could be easily adapted to an automated, dosimeter-reading system with the digital output stored or recorded in any one of several available forms. (BBB)

47388 THERMOLUMINESCENT DOSIMETER FOR DETECTING RADIATION HAVING A PLURALITY OF COMPONENTS. Schayes, Raymond; Kozlowitz, Isidore (to Societe Anonyme, Manufacture Belge Lampes et de Materiel Electronique). U. S. Patent 3,399,301. Aug. 27, 1966. Priority date Jan. 29, 1965, Belgium.

A thermoluminescent dosimeter employing two or more active elements mounted within a common envelope is described. Each of the active elements is responsive to a particular form of a radiation so that radiation having two or more components can be be detected. A common heating element serves to heat the active elements simultaneously so that all radiation components can be detected simultaneously. (auth)

Radiometric Instruments

47389 MEASURING SYSTEM. (to Industrial Nucleonics Corp.). British Patent 1,126,767. Sept. 11, 1968. Priority date Sept. 18, 1964, United States.

The design of a radiometric gage for measuring characteristics of materials such as thickness and density is presented. The source-collimator-detector geometry is described. (W.H.K.)

47390 RADIOISOTOPES IN THE STEEL INDUSTRY. Booth, E. (Australian Iron and Steel Pty. Ltd., Port Kembla, New South Wales). At. Energy Aust., 11: No. 3, 9-12(July 1968).

The use of radioisotopes and nuclear methods in the production of steel is discussed. The uses of radiometric instruments for bulk analysis, moisture determination, level gaging, weighing, measuring flow rates, measuring slag formation and scrap melting rates, thickness measurements, and others are cited. (W.H.K.)

47391 DESIGN PROCEDURE FOR NUCLEAR LEVEL GAGES. Thomason, E. M. (Monsanto Co., Texas City, Tex.). Instrum. Technol., 15: 51-4(June 1968).

A straightforward technique for fixing design variables was developed to guide the design of nuclear radiation systems for continuous level measurement. The design of a nuclear system for measurement of liquid level within a vessel can be carried out by the following steps. Obtain all pertinent data about the application, such as vessel ID, vessel wall thickness and material, presence of additional insulating materials between source and detector, such as water jackets, brick linings, etc., density of material being measured, and length over which level measurement is to be made. Determine the number of half-values of absorption represented by all materials between source and detector. Determine the radiation reduction ratio. Determine the average level of radiation desired at the detector. Determine the radiation level in air at the maxi-

mum angle between source and detector for the particular type source. Determine the source strength required for this application. Calculate the residual radiation to determine the amount of radiation background to expect when the tank is full. If there is any buildup on the walls of the vessel, the error caused by this should be calculated. An example is provided, showing how calculations in the various steps are made. (BBB)

47392 STUDY OF SOLID COMPONENT DISTRIBUTION IN CHAMBER OF DRAGGED GAS SUSPENSION COUNTER-FLOW BY BETA RAYS. Belyi, L. M.; Gorbis, Z. R.; Shumakov, I. K. Inzh.-Fiz. Zh., 15: 66-72(July 1968). (In Russian).

A radiometric densimeter using beta particles is described for measuring the heavy-particle aerosol concentration in gases. (W.H.K.)

47393 RADIOLOGICAL CAMERA COMPRISING A SHIELDED CONTAINER HAVING A TORTUOUS PASSAGEWAY. Spencer, Leo G. U. S. Patent 3,393,317. July 16, 1968. Filed Apr. 24, 1964.

A gamma camera in which the gamma source is contained within a shielded container and rollers are provided on the container so that it may be moved along a pipe line for inspection is described. Also, means are provided for moving the source from a safe position within the camera to a position where it may be used for inspecting the pipe. (W.H.K.)

47394 METHODS OF MEASUREMENT OF A LEVEL BY GAMMA RADIATION. Quivy, Robert (Faculte Polytechnique, Mons, Belgium). Silicates Ind., 30: 507-10(Sept. 1965). (In French).

Monoenergetic γ rays are absorbed by material according to an exponential law as a result of Compton events, photoelectric effect, and pair creation. One can detect the presence or absence of material, or the thickness of this material, between source and detector, as a result. A liquid level can be placed with reference to a source so that detection of the falling of the level below the source increases the counting rate of the detector greatly. Continuous level monitors can be arranged by several schemes: several sources and a single detector, one source and several detectors, continuous absorption, or a floating source with several arrangements of the detector. The source may be either a γ source or a Bremsstrahlung source and should be chosen after consideration of the merits of the individual problem. Advantages and disadvantages of Geiger counters, ionization chambers, and scintillation counters for specific cases are discussed. (BBB)

Miscellaneous Instruments and Components

Refer also to abstracts 47241, 47242, and 47382.

47395 (AI-AEC-12700) EVALUATION OF AN ELECTROCHEMICAL OXYGEN METER. Murbach, E. W.; Heath, N. W. (Atomics International, Canoga Park, Calif.). June 30, 1968. Contract AT(04-3)-701. 24p. Dep. CFSTI.

Two electrochemical oxygen meter probes which have been operated in the Systems Quality Sodium Loop are described. Both electrodes were responsive to oxygen injections; however, due both to the interaction of stainless steel with oxygen and to the imprecision of analysis for oxygen below about 5 ppM in sodium, only qualitative results were obtained. The emf of the first electrode appeared to have a long term downward drift. The second electrode has been quite stable during five months of operation. The temperature coefficient of the second electrode is approximately zero. The apparent temperature coefficient of 0.5 mV/°F is a result of a shift in the equilibrium of the stainless steel-oxygen-sodium system. (auth)

47396 (BNWL-715(Pt.1)) ANNUAL REPORT FOR 1967 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME II. PHYSICAL SCIENCES. PART 1. INSTRUMENTATION. Spear, W. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1968. Contract AT(45-1)-1830. 67p. Dep. CFSTI.

Separate abstracts were prepared for 7 of the 10 papers presented. Three papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual sections see: 47311–47315, 47397, and 47441.

47397 (BNWL-715(Pt.1), pp 38-41) DEVELOPMENT IN THE TIDAL VOLUME AIR MEASUREMENT. Wilbur, R. L. (Battelle-Northwest, Richland, Wash.).

Studies of deposition of inhaled radionuclides in canines require an accounting of the amount of air respired. An earlier instrument merely counted the breaths and measured the inhalation volume. Modifications to the basic instrument enable the digital portion of the device to accept many different transducers and to examine either the inhalation or the exhalation portion of the respiration cycle. Two remote operating stations increase the mobility and versatility of the instrument. Several internal circuit changes are described which provide greater breath monitoring latitude, smoother printer operation, and greater operator safety. (auth)

47398 (IA-1167) SOME COLLIMATION PROBLEMS IN NEUTRON DIFFRACTOMETRY. Epstein, A.; Shaked, H. (Israel Atomic Energy Commission, Tel Aviv). Dec. 1967. 17p. Dep.

Two experimental curves of full width at half maximum (WHM) versus the resolution parameter $a = \tan\theta/\tan\theta_M$ are given. The mosaic spread, β, of the Cu (002) monochromator is obtained by searching for the best fit between the theoretical and experimental curves. The general behavior of luminosity, WHM, is discussed in view of some theoretical computations. (auth)

47399 (JINR-P13-3953) INVESTIGATION OF POSSIBLE APPLICATION OF THE MAGNETRON TYPE ION SOURCE IN THE ON-LINE ELECTROMAGNETIC SEPARATOR. Dem'yanov, A. V.; Kabachenko, A. P.; Loginov, O. P.; Tarantin, N. I.; Tyrroff, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 20p. (In Russian). Dep.

The results of the experiments with the gas-discharging ion source of a magnetron type which operates in a regime near that of the electromagnetic separator on-line with the cyclotron, are presented. The problems of the ionization efficiency, the ion beam focusing, and optimal dimensions of an ion source construction for the ultra-small quantities of radioactive atoms are investigated. The work was performed in connection with the construction of the electromagnetic separator on-line with the heavy-ion cyclotron in the LNR of the JINR. (auth)

47400 (K-L-6211) BIO-PARTICLE CARBON ANALYZER OPERATION AND MAINTENANCE MANUAL. Stevens, R. H.; Kermicle, H. A. (comps.) (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 30, 1968. Contract W-7405-eng-26. 53p. Dep. CFSTI.

Operation and maintenance of an instrument for analyzing individual biological particulates such as cells, pollen, and spores for carbon by sampling them from a drop of liquid media onto a moving wire and analyzing each particle separately in a solid-sample type of hydrogen flame ionization detector are described. The smallest detectable carbon weight is approximately 10^{-12} gram. (W.H.K.)

47401 (LA-DC-9383) INTEGRATION OF ULTRASONIC BOND SIGNALS. Edenborough, N. B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 13p. (CONF-681004-1). Dep. CFSTI.

From 28th National Fall Conference of the American Society for Nondestructive Testing, Detroit, Mich.

A circuit is described which integrates the ultrasonic signal from a bonded joint. This circuit is capable of measuring the percent of bond over any size area. Used in the circuit is a voltage-to-frequency converter which converts the analog gate signal to a frequency and a pulse counter. The number of pulses received over a length of scan is a function of the percent of bond. (auth)

47402 (NYO-3664-10) A FAST STORAGE SYSTEM FOR PULSE-HEIGHT DATA AND EXPERIMENTS ON 31-MILLISECOND ^{155m}Gd. Etzion, Moshe (Cornell Univ., Ithaca, N. Y. Nuclear Reactor Lab.). Jan. 1968. Contract AT(30-1)-3664. 170p. (CURL-28). Dep. CFSTI.

Thesis.

A fast temporary storage system for pulse amplitudes which was developed for use in pulse-height analysis of millisecond half-life isomers is described. The electrostatic system can store about a thousand pulses and has a uniform dead time of 1 μsec. Also, experiments on 31-millisecond ^{155m}Gd are described. The isomer was produced by pulsed neutron irradiation of a sample enriched in ^{154}Gd in the Cornell TRIGA reactor. Gamma and x-ray measurements were performed using Ge(Li) and NaI (Tl) detectors. Energies of 86.2 ± 0.4 keV and 42.7 ± 0.45 keV were measured corresponding to the known second excited state of ^{155}Gd ($T_{\frac{1}{2}}$ = 5 nsec) and to gadolinium K x-rays. The isomer half-life was determined to be 31.4 ± 1.5 msec. The K conversion coefficient of the 86.5 keV level was calculated from spectra of both detectors. The results were 0.39 ± 0.03 for the Ge(Li) spectra and 0.43 ± 0.03 for the NaI (Tl) spectra. (W.H.K.)

47403 (TID-24687) PULSE RESPONSE OF COAXIAL CABLES: COUNTING NOTE. Kirsten, F.; Wallace, R. (California

Univ., Berkeley. Lawrence Radiation Lab.). Revised July 29, 1966. 13p. Dep. CFSTI.

For most cables useful in counting work, attenuation below approximately 1000 MHz is due mainly to skin-effect losses and varies as the square root of frequency. For such cables the step-function response has a rise time that varies as the square of the attenuation at a given frequency. Curves are given to aid in the selection of cables for transmitting nanosecond pulses. (auth)

47404 (UCRL-50457) LASER TELEMETRY PROGRAM. Adams, W. E.; Horning, R. R. (California Univ., Livermore. Lawrence Radiation Lab.). July 3, 1968. 35p. Dep. CFSTI.

The Lawrence Radiation Laboratory at Livermore has supported the development of experimental laser telemetry systems to transmit nuclear diagnostic information. The basic concept of a laser telemetry system is described, problem areas are indicated, some experimental results obtained at the Nevada Test Site are given, and future plans are briefly mentioned. (auth)

47405 (UUIP-596) MULTICHANNEL PULSE HEIGHT ANALYZER WITH DIGITAL ADDRESS AND ANALOG MEMORY. Westman, A.; Petrusson, E.; Tove, P. A. (Uppsala Univ. (Sweden). Inst. of Physics). June 1968. 8p. Dep.

An investigation is presented on the performance of an analog memory for multichannel pulse height analysis. The memory consists of 64-μF memory capacitors connected to junction FET switches which are controlled from a diode matrix fed from two series-connected scales-of-eight. The first of these receives the addressing pulses, which are obtained from a pulse-height to digital converter. The pulse processing time is 64 μsec. The decay of a stored spectrum is of the order of 2 percent for 24 hours. The differential linearity is at present limited by inequality of capacitor values (2 percent) but it is possible to bring this down to below the statistical uncertainty at the highest count number. A maximum of 10^5 stored pulses per channel were used. The potential advantage of the system is an economical construction, especially if integrated techniques are used, and the speed, which could be increased one order of magnitude and more, relative to the figure quoted above. Draw-backs are limited storage time and the precautions necessary to get precise equality of channels. (auth)

47406 DEVICE FOR MEASURING REACTOR REACTIVITIES. Sujuki, Kenji (to Nippon Atomic Industry Group Co., Ltd.). Japanese Patent 1968-4910. Feb. 22, 1968. Filed Sept. 27, 1963.

A reactivity meter is described, composed of an amplifier, recorder, and a voltage multiplier with a feedback circuit. (TSS) (NSA of Japan)

47407 NUCLEAR INSTRUMENTATION NO. 32. Bull. Instr. Nucl., No. 32, 1-84(Mar. 1968). (In French).

The eleven papers presented at the information sessions in Saclay, December 14-15, 1967, are compiled. The topics discussed were contribution of the CEA to the development of a French nuclear industry, automation of counting systems, automatic radiation measurement devices, functional elements radioprotection with a brief description of the industrial realization made at the EDF-4, DIDAC 800 and DIDAC 4000 data processing installations, liquid scintillation spectrometers, development of nuclear spectrometers with semiconductor detectors and fast electronics, recent developments in the region of radiation detectors, and new measurement devices. These devices include oscilloscopes, pulse generators, and modules for pulse generators. (J.S.R.)

47408 COMPUTER DATA LINK FOR HIGH-ENERGY PHYSICS EXPERIMENTS. Andreae, Sypko W. (Univ. of California, Berkeley). pp 139-44 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

At LRL small computers are used on-line with high-energy physics experiments. A fast two-way data link between one or more of these small computers and a large computer is described. The main components of the data link are interfaces for the two computers, a buffering and error-correcting system, and a transceiver system using 1-mile-long telephone lines. A unique demand and response system maintains synchronization and supports a highly accurate error-correction system. Control words communicate word count, transfer direction, etc., between the computer programs. Special high-reliability pulse-train signals transmit critical information, such as error and end-of-record between the interfaces. (auth)

47409 AUTOMATIC CALIBRATION AND EVALUATION OF MULTICHANNEL ANALYZERS USING A PDP-8. Black, W. Wayne (Idaho Nuclear Corp., Idaho Falls). pp 103-12 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

A complete package of PDP-8 programs which have been developed for automatic evaluation and calibration of multichannel analyzer systems is described. These programs require a basic PDP-8, a specially designed computer-controlled pulser, and a DEC type 160B interface for dual analog-to-digital converters (ADC's). The programs permit the following parameters to be measured: stability of the ADC zero reference level, stability of the system gain, deviation of the system from a linear response, and ADC channel profiles. These parameters can be measured for any ADC ramp length up to 4096 channels with an accuracy of 5 parts in 100 thousand. (auth)

47410 ANALYSIS OF MULTICHANNEL ANALYZER DATA WITH LIGHT PEN AND FUNCTION BOX TECHNIQUES. Richardson, C. Wendell (Phillips Petroleum Co., Idaho Falls, Idaho). pp 95-101 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

A software program package which was developed for a 4K PDP-8 computer using a stepping recorder and DECtape to readily access and store 4096 channel data from a multichannel analyzer is described. An inexpensive 21-inch display console, light pen, and function box are used to study the data, make fast preliminary calculations to determine parameters, and obtain final results. The need for listings and plots has been eliminated and an analysis can be completed immediately after the data are taken. (auth)

47411 DECUS PROCEEDINGS, FALL 1967. Papers and Presentations, Fall Symposium, Computers in the Laboratory, November 10, 11, 1967, Anaheim, California. Maynard, Mass., Digital Equipment Computer Users Society, 1968. 217p. (CONF-671123).

Separate abstracts were prepared for 8 of the 26 papers presented. The remaining 18 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 47362–47364, 47376, 47408–47410, and 47414.

47412 NUCLEAR TEST INSTRUMENTATION WITH MINIATURE SUPERCONDUCTIVE CABLES. Rathbun, D. K. (Sandia Corp., Albuquerque, N. Mex.); Jensen, H. J. Contract AT(29-1)-789. IEEE (Inst. Elec. Electron. Eng.), Spectrum, 5: No. 9, 91-9(Sept. 1968). (SCL-DC-67-121).

The instrumentation requirements for nuclear testing are particularly stringent because of the nature of the transients involved and because of the distance at which instrumentation must be placed. Presently used high-quality transmission lines are not capable of nanosecond performance where cable runs of approximately 1000 meters are concerned. Experimental data from the U. S. Atomic Energy Commission's Nevada Test Site which are presented show that 30-ns rise times are attainable for a superconductive cable 7620 meters long. Although the performance of conventional cables (normal conductors) can be improved by low-temperature operation, superconductive cables operated at the same temperature offer bandwidths 100 times greater. (auth)

47413 USE OF A MAGNETORESISTOR TO MEASURE THE MAGNETIC FIELD IN A SUPERCONDUCTING MAGNET. Scott, G. B.; Springford, M.; Stockton, J. R. (Univ. of Sussex, Brighton, Eng.). J. Phys., E (London), 1: 925-8(Sept. 1968).

The use of a copper magnetoresistor to monitor magnetic fields in a superconducting magnet, where the magnetic field is not uniquely related to the energizing current, is described. Calibration to 100 kG is achieved by nuclear magnetic resonance in ^{27}Al. A curve-fitting procedure based on the method of orthogonal polynomials allows interpolation to any magnetic field. Above 30 kG the magnetoresistor allows field measurements with an accuracy to 0.1%. (auth)

47414 THE PDP-9 SYSTEM AT THE UNIVERSITY OF MANITOBA CYCLOTRON. Funk, L. W.; Jovanovich, J. V.; Kawchuck, R.; King, R.; McKeown, J.; Miller, C. A.; Peterson, D.; Reimer, D.; Standing, K. G.; Thompson, J. C. (Univ. of Manitoba, Winnipeg, Can.). pp 187-92 of DECUS Proceedings, Fall 1967. Maynard, Mass., Digital Equipment Computer Users Society, 1968.

From Fall Digital Equipment Computer Users Society Symposium, Anaheim, Calif. See CONF-671123.

A PDP-9 system and its on-line uses in the following experiments are described: measurement of p-p bremsstrahlung cross sections using wire chambers with magnetic core readout; measurement of relative abundance of certain mass isotopes using a Nier type mass spectrometer; and simultaneous recording of two 64 × 64 channel pulse height spectra using one analog-to-digital converter. (auth)

47415 EVALUATION OF LUMINOSITY OF RADIOISOTOPIC CALIBRATED LIGHT SOURCES AS A FUNCTION OF ABSORBED ENERGY. Gel'fman, A. Ya.; Daich, A. R.; Tsirlin, Yu. A. (All-Union Scientific-Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 5, 247-8(Sept.-Oct. 1967). (In Russian).

The luminosity of radioisotopic calibration light sources as a function of the energy absorbed by the scintillator, self-absorption, and intrinsic light scattering was studied using a disc-shaped light source made of scintillation plastic (polystyrene + 2% paraterphenyl + 0.1% POPOP) excited by β radiation from a $^{90}Sr + ^{90}Y$ (9.3×10^7 decay/min in 2π) source enclosed by a 10 nm thick aluminum foil. The source superimposed on the scintillator was placed in an aluminum container. A FEU-29 was used as a luminosity detector. It was found that for the 13 mm-diameter plastic scintillator with optimum thickness (6 mm) the K (coefficient as a function of the dose, shape and dimensions of plastic scintillator) is equal to 1.54×10^{-13}. The source luminosity for this is 7.8×10^{-9} candles. (R.V.J.)

47416 APPARATUS FOR OBSERVING QUADRUPOLE SPIN ECHO AT 150 TO 300 MHz. Gushchin, S. I.; Shishkin, V. A.; Derendyaev, B. G. (Perm State Univ., USSR). Prib. Tekh. Eksp., No. 5, 195-7(Sept.-Oct. 1967). (In Russian).

A description is given of a 150-300 MHz quadrupole spin-echo instrument, the radio-frequency pulses being produced by a pulse circuit with cathode and plate tuning. (auth)

47417 USE OF PARAMETRICALLY EXCITED CIRCUIT AS A SIGNAL TRANSDUCER IN NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. Dzbanovskii, N. N.; Konstantinov, Yu. S.; Yashin, A. Z. (Moscow State Univ.). Prib. Tekh. Eksp., No. 5, 188-91(Sept.-Oct. 1967). (In Russian).

The NMR head described has a circuit excited by a periodically varying capacitor, which is modulated by a crystal oscillator whose frequency is twice the NMR frequency. Various modes of operation are examined. The system has been used to observe narrow and broad NMR lines. (auth)

47418 NOISE-IMMUNE IONIZATION MANOMETER FOR PLASMA EQUIPMENT. Kotel'nikov, Yu. N.; Kutukov, G. P.; Simonov, V. A. Prib. Tekh. Eksp., No. 5, 206(Sept.-Oct. 1967). (In Russian).

Construction of a noise-immune ionization manometer which may be used for measuring neutral gas densities and flows in the operating regimes of the Tomamak-2 and Tomamak-3 thermonuclear research reactors is divided. The noise immunity is attained by screening of the ionization space from the effect of the modulating voltage. (W.H.K.)

47419 THERMOSTATING DURING MEASUREMENTS IN LIQUIDS BY THE SPIN-ECHO METHOD. Gaisin, N. K. (Kazan State Pedagogical Inst.). Prib. Tekh. Eksp., No. 5, 200-2(Sept.-Oct. 1967). (In Russian).

A method of thermostating by means of a gas flow during temperature measurements of the time of spin-lattice relaxation in liquid specimens on a spin-echo spectrometer is described. The interval of temperature change is from –130°C to +250°C, accuracy is ±0.5°C. Elimination of the temperature gradient and the convection caused by it in the specimen is effected by the double pass method and suitable choice of the direction of flow. (auth)

47420 PHOTOELECTRONIC MULTIPLIER SPARK-OVER INDICATOR. Dunaitsev, A. F.; Prokoshkin, Yu. D. Prib. Tekh. Eksp., No. 5, 245-6(Sept.-Oct. 1967). (In Russian).

When the voltage across a photomultiplier reaches a certain value, the noise increase acquires an avalanche character and the phenomenon of spark-over develops. A spark-over indicator, which consists of a neon lamp in parallel with the latter intervals of the photomultiplier, is described. (W.H.K.)

47421 STABILIZED HIGH-VOLTAGE SOURCE FOR EXCITING PHOTOMULTIPLIERS. Orlov, R. A. Prib. Tekh. Eksp., No. 5, 202-3(Sept.-Oct. 1967). (In Russian).

A high-voltage source, implemented with semiconductor devices, for exciting photoelectric multipliers is described. The range of change of output voltage is 0.8-2.0 kV. Maximum load current is 4 mA. The circuit works over the temperature range of –10 to +40°C. Experimental results are presented. (auth)

47422 MOESSBAUER SPECTROMETER. Tomov, T.; Ruskov, T. (Scientific-Research Inst. of Geology, Sofia. Inst. of Physics, Sofia). Prib. Tekh. Eksp., No. 5, 138-42(Sept.-Oct. 1967). (In Russian).

A velocity modulator for Moessbauer-effect investigations which produces variable-velocity double-parabolic motion from 10^{-3} to 40 cm/sec and sinusoidal motion up to 150 cm/sec is described. (auth)

47423 THE PHOTOELECTRON MULTIPLIER FEU-77 FOR RECORDING LIGHT PULSES FROM OPTICAL QUANTUM GENERATORS (LASERS) IN THE 700-nm RANGE. Dukor, S. G.; Kononchuk, L. V.; Leiteizen, L. G. Prib. Tekh. Eksp., No. 5, 207-9(Sept.-Oct. 1967). (In Russian).

A new timing photoelectron multiplier, the FEU-77, sensitive to the long-wave part of the spectrum and having a low characteristic noise level, is described. The constructional features of the apparatus are indicated together with its working parameters and characteristics. (auth)

47424 APPARATUS FOR GENERATING NANOSECOND X-RAY PULSES. Belkin, N. V.; Tarasov, M. S. Prib. Tekh. Eksp., No. 5, 229-30(Sept.-Oct. 1967). (In Russian).

An apparatus is described for the generation of x-ray pulses 10-20 nsec wide having intensities of $10^6 - 10^7$ quanta per pulse. High-amplitude voltage pulses (120 kV) having a rise time of 50 nsec were obtained by use of a pulse transformer. The x-ray generating element was a small dual electrode vacuum discharge tube. (auth)

47425 NOISE-IMMUNE VERY-HIGH-VACUUM MANOMETER WITH DOUBLE MODULATION OF ION CURRENT. Kotel'nikov, Yu. N. Prib. Tekh. Eksp., No. 5, 204-5(Sept.-Oct. 1967). (In Russian).

An ionization manometer, intended for measurement of a very high vacuum in a magnetic field in the presence of noise from charged foreign particles is described. (auth)

47426 AUTOMATIC DEAD-TIME CORRECTION IN THE AI-100 PULSE-HEIGHT ANALYZER. Vinokurov, V. A.; Vesnovskii, S. P. Prib. Tekh. Eksp., No. 5, 178-81(Sept.-Oct. 1967). (In Russian).

A description is given of a device for correcting automatically for the dead-time in an AI-100 pulse-height analyzer operating up to $1.5 \cdot 10^4$ sec^{-1}. The circuit is given for the timer, which produces pulses with frequencies of 333.3, 166.6, and 66.6 Hz, and for the gating device. (auth)

47427 MAGNETLESS TRANSIT-TIME MASS SPECTROMETERS. Pavlenko, V. A.; Ozerov, L. N.; Rafal'son, A. E. Zh. Tekh. Fiz., 38: 581-602(Apr. 1968). (In Russian).

A review of the present status of transit-type mass spectrometers is presented. The principles of the theory of magnetless transit-time mass spectrometers, descriptions of the mass-spectrum recording devices, descriptions of the Soviet and foreign mass spectrometers, and examples of application of transit-time spectrometers are given. It is shown that the advantages of these mass spectrometers (high repetition frequency of the mass spectra, small ionization time, wide range of mass variation, simplicity of adjustment) are offset by certain disadvantages (small resolution, low sensitivity, low accuracy), and prospects for improving the operation of transit-time mass spectrometers are discussed. (ATD)

47428 BROAD-BEAM MASS SPECTROMETER HAVING PARTICLE ENERGY SELECTION MEANS. Saari, John M.; Schoen, Richard L.; Dayton, Irving E. (to Boeing Co). U. S. Patent 3,397,311. Filed Feb. 12, 1965.

An apparatus for selecting ions of predetermined masses is described. Electrodes defining the ion source are energized to impart substantially constant momentum to the ions in a first direction. A transparent intercepting grid imposes a force on the ions in a second direction parallel but opposite to the first direction so that only those ions exceeding a predetermined energy level pass through the intercepting grid. Of these ions, those below a predetermined energy level are reflected by a second intercepting grid to a collector electrode to be measured. (U. S. Pat. Gazette)

47429 TRIGGATRONS OF HIGH-CURRENT PULSE GENERATORS. Lenarczyk, H.; Melzacki, K.; Pietruszka, J. (Inst. of Nuclear Physics, Krakov). Postepy Fiz., 14: 271-90(1968). (In Polish).

A review of the design and technical properties of various types of high-current triggered switches is presented. (auth)

47430 CONTINUOUS CARBON METER FOR SODIUM SYSTEMS. McKee, John M.; Caplinger, Wayne H.; Kolodney, Morris (United Nuclear Corp., Elmsford, N. Y.). Nucl. Appl., 5: 236-46(1968).

A diffusion-cell type of carbon meter is useful for continuous measurement of the carburizing potential of liquid sodium. The iron sensing element is small and long lived and responds rapidly to changes in carburizing potential. Measured carbon fluxes through the iron probe wall ranged from 0.007 to 1.7 μg cm^{-2} min^{-1} in response to carburizing additives to the sodium. Stainless steel tabs in the sodium carburized at a rate that varied from

negligible to rapid over this range. Carbon monoxide and unstable carbides were found to produce a high carbon activity in the sodium, whereas elemental carbon in the absence of oxygen had little effect.

47431 SANDIA SAMPLER (Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE–1760).
11 drawings.

The telemetry module used in the payload section of the Sandia Laboratory's upper atmosphere sampling rocket system is described. The module is self-contained, watertight, and completely independent of the payload case. The module withstands vibration cycling, temperature shock, temperature exposures, linear acceleration in a longitudinal direction, rotation about the longitudinal axis, mechanical shock, and hydrostatic pressure. (For details See TID-4100 Suppl. 47).

47432 ION SOURCE FOR MASS SPECTROMETERS. Alexandru, Gr. (Inst. of Atomic Physics, Bucharest). Rev. Sci. Instrum., 39: 1571-2(Oct. 1968).

An ion source for a mass spectrometer allowing the simultaneous introduction and measurement of sample and reference standard is described. It is useful for detection of very small differences in isotopic composition of elements. The residual background interference on the measurements is considerably reduced. (auth)

47433 MASS SELECTOR FOR ION BEAM EXPERIMENTS. Theard, Lowell P. (Douglas Advanced Research Labs., Huntington Beach, Calif.). Rev. Sci. Instrum., 39: 1464-80(Oct. 1968).

A mass selector which efficiently produces mass filtered beams of both primary and secondary ions in the medium current ranges is described. Currents up to 10^{-6} A for the mass filtered beam can be obtained with beam energies of 3–5 keV. Ions are produced in a hot cathode, gas discharge ion source of relatively simple construction, and are extracted as a parallel beam. Mass analysis is accomplished over a short pathlength with a compact, high current, sector field electromagnet which is entirely contained within the analyzer chamber. An electrostatic quadrupole lens is used for optimum shaping of the incident ion beam for high transmission through the magnetic sector. A second quadrupole lens is used to restore parallelism to the mass filtered ion beam and is mounted beyond the image slit, which was made wide enough to pass the entire image focused beam. The instrument has no object slit, as the entire incident beam is brought to a crossover at the object position. Beam transmission through all elements in the analyzer chamber, including the two quadrupole lenses, the sector magnet, and the image slit, is approximately 50%. Oscillating beam scanners are used to measure the beam density profile and to monitor the mass spectrum. The resolving power for spatial separation is about 60. Secondary ions such as N_2^+ and CH_2^+ can be generated with intensities comparable to those of primary ions. (auth)

47434 MONOPOLE MASS SPECTROMETER. Dawson, P. H.; Whetten, N. R. (General Electric Research and Development Center, Schenectady, N. Y.). Rev. Sci. Instrum., 39: 1417-22(Oct. 1968).

Monopole mass spectrometer characteristics are determined by analyzing ion trajectories under various operating conditions. The trajectories were computed by numerical integration of the Mathieu equations of motion. The mode of operation was chosen to correspond with that in general use, with ion injection being parallel to the axis of the instrument. The simulation was made specific by considering a monopole under operating conditions such that an ion with m/e = 72 spends 12 rf cycles within the field. Information was obtained concerning peak shape, sensitivity, and resolution. The influence of entrance and exit slit dimensions and of rod-Vee block spacing was determined. (auth)

47435 MULTIPLE PORT FLUID CONNECTION (Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE–1761).
2 drawings.

A multiple port fluid connector designed for a fluid powered switching system utilizing 320 binary air signals is described. Space requirements were reduced by adapting the electric signal connect and disconnect method to fluid signals. Electrical contacts were removed and replaced with ½ in. ID thin wall tubing. Seven 50-tube cables in the system interconnect a tape read, control chassis and cross switch chassis. (For details see TID-4100 Suppl. 47). (F.S.)

47436 DIGITAL INTERFACE FOR OFF-LINE SCINTISCAN DATA PLOTS. Kawin, Bergene; Blackwell, Robert B. (Veterans Administration Hospital, Washington, D. C.). Bio-Med. Eng., 3: 18-19(Jan. 1968).

An interface to interpret digital scintiscan data, recorded on paper tape, to a digital plotter is described and discussed. A computer prepares plotting instructions on punched paper tape. In the off-line system used these computer-prepared instructions are translated by an interface circuit to drive a digital plotter, which produces the curve configuration for evaluation of scintiscan results. The circuit used for the interface, which will provide pulses from the tape instructions and drive the digital incremental plotter, is shown and its operation is described. The advantage of the circuit design presented is that it is possible to crosspatch the signals to produce specified pen functions from any decimal value of the code punched on tape. Consequently, the interface can operate compatibly to drive the digital plotter from whatever code configuration is used to record measurement data. (BBB)

47437 RADIOACTIVE VOLTAGE STANDARD. Braudaway, David W. (Sandia Corp., Albuquerque, N. Mex.). ISA (Instrum. Soc. Amer.) Trans., 6: 273-7(1967).

Standard cells that serve as a voltage reference are vulnerable to environment and use conditions. An alternate method of generating a voltage that is related to predictability of radioactive decay is described. The design and characteristics of a working model of the calorimeter necessary to utilize this method are presented briefly. Also discussed are the characteristics of the required radioactive source. (auth)

47438 NEW TYPE OF HIGH SPEED VALVE. Inoue, N.; Uchida, T. (Nagoya Univ., Japan). Rev. Sci. Instrum., 39: 1461-4(Oct. 1968).

A new type of high speed operating valve for theta pinch devices in plasma physics research is described. The valve is thin enough to be set between the theta pinch coil and the discharge tube. The operation of the valve depends on the force exerted between two parallel electric currents. The gas is injected from the wall of the discharge tube so that an amount of gas is initially confined in the discharge region. Azimuthal distribution of the gas admitted is found to be uniform by measurement with a fast ion gauge. The opening time of the valve is less than about 350 μsec. The amount of gas admitted for a given setting is reproducible to less than ±5%. (auth)

47439 VIBRATING COIL MAGNETOMETER FOR MEASUREMENTS ON TYPE II SUPERCONDUCTORS. Farrell, D. E. (Case Western Reserve Univ., Cleveland). Rev. Sci. Instrum., 39: 1452-6(Oct. 1968).

Problems involved in the measurement of magnetization in type II superconductors are briefly considered. A simple vibrating coil magnetometer has been developed for use at temperatures above 1.5 K with a sensitivity of 10^{-4} emu, permitting quantitative tests to be made of some recent developments in the theory of type II superconductors. (auth)

47440 FAST METALLIC CONTACT SOLID DIELECTRIC SWITCH FOR HIGH VOLTAGE AND CURRENT. Henins, Ivars; Marshall, John (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instrum., 39: 1481-4(Oct. 1968).

A metallic contact solid dielectric switch with a closing time of 10.13 μsec is described. An electrically exploded foil is used to drive a 0.317 cm thick aluminum plate through 0.076 cm polyethylene insulation into solid contact with the other switch electrode. The switch has been used as a series switch in a 20 kV circuit with a current of 1.2×10^6 A rising in 40 μsec. In a crowbar application it has carried 40 kA with a 1/e decay time of 45 msec. (auth)

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 48154.

47441 (BNWL–715(Pt.1), pp 15-20) IRRADIATION EFFECTS ON SEMICONDUCTOR DETECTORS AND COMPONENTS. Philipp, L. D.; Hoitink, N. C. (Battelle-Northwest, Richland, Wash.).

The operating characteristics of semiconductor devices such as field effect transistors and diode detectors must be known to accurately predict circuit/detector operation in ionizing radiation environments. During irradiation of metal-oxide-semiconductor (MOS) transistors, a positive charge builds up in the surface oxide layer and surface states are introduced which change the operating characteristics of the device. Irradiation of 33 devices, representing 3 types of units, in the ^{60}Co gamma facility demonstrated that radiation resistance can be improved by proper selection of device type and operating point. (auth)

47442 (N–68-23246) RADIATION EFFECTS ON SILICON. Summary Report, November 1, 1965–April 20, 1967. Naber, J. A.; Horiye, H.; Wikner, E. G. (General Dynamics Corp., San

Diego, Calif. General Atomic Div.). June 20, 1967. Contract NAS7-289. 91p. (NASA-CR-94536; GA-8016). CFSTI.

Research on the radiation-induced displacement effects in silicon, including excess minority-carrier lifetime and electron spin resonance measurements is discussed. The displacement effects were produced by 30-MeV electrons at room temperature; both low and high resistivity (ultrapure) n- and p-type silicon were investigated. The defects in the high-purity n- and p-type silicon were near the center of the energy gap and were possibly intrinsic. The characteristics of these defects were determined by the excess minority-carrier lifetime as measured by the microwave-reflection technique. In the low-resistivity silicon, the defects in the Czochralski-grown (QC) silicon were oxygen-dependent, whereas the defects in the vacuum pulled (FZ) silicon were impurity-dependent. The defects in this low-resistivity silicon were measured by dc conductivity. ESR measurements yielded information about divacancy production, the position of the divacancy energy levels in the energy gap, and Si—G8 formation. However, complete correlation between ESR-detected centers and carrier lifetime recombination levels was not obtained. (auth) (STAR)

47443 (N-68-24660) HIGH-ENERGY PROTON DAMAGE IN SILICON SURFACE-BARRIER DETECTORS. Singh, Jag J.; Rind, Emanuel (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). May 1968. 33p. (NASA-TN-D-4528). CFSTI.

The performance of a number of silicon surface barrier detectors has been studied under bombardment with 5.0-MeV, 20.0-MeV, and 40.0-MeV protons. The detectors investigated fall under three categories: normal 100 microns deep; normal 500 microns deep; and fully depleted (dE/dx) type, 500 microns deep. Measurements made include rate of deterioration of charge collection efficiency, variation of resolving power, variation of leakage current, variation of noise level, and changes in detector capacitance as a function of the incident proton dose. From these data, formulas giving relationships between the proton dose and the degree of detector resolving power deterioration have been developed for the normal and fully depleted type of detectors. Measurements clearly establish that the fully depleted detectors are more radiation damage resistant than the normal detectors; the increased collecting field across the sensitive region reduces the damage sensitivity; and the damage threshold of detectors made from lower resistivity materials is higher than that of those made from higher resistivity materials. In the case of dE/dx detectors, there was no convincing evidence of any difference in degradation rates when viewed from the positive or negative sides of the detectors. (STAR)

47444 (N-68-25414) RADIATION METHOD OF IMPROVING THE TEMPERATURE CHARACTERISTICS OF SILICON SEMICONDUCTOR STRAIN GAGES. Gross, Chris (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). [1967]. 18p. (NASA-TM-X-60498). CFSTI.

The thermal coefficient of resistance (TCR) of n- and p-type silicon semiconductor strain gages may be substantially reduced by irradiating them with 2 MeV electrons. The thermal coefficient of gage factor (TCGF) may also be reduced in some resistivities of irradiated n-type gages. The reduction results from the majority carrier concentration increasing with temperature and, hence, compensating for the usual decrease in carrier mobility with temperature. This method has been applied to n- and p-type gages fabricated from silicon of several different resistivities. The reduction was found to depend on the type and resistivity of the material and the ingrated electron flux. The largest reduction in TCR occurred in the irradiated 0.045 ohm-cm n-type and 10 ohm-cm p-type silicon gages. The TCR of these gages after irradiation was approximately 1%/100°C in the temperature interval from 0°C to 100°C, or about a factor of 40 to 50 times smaller than their preirradiated value. The TCGF of these same gages was slightly reduced after irradiation. The absolute value of the gage factor was reduced by only about 5% of its original value. The irradiated gages could be operated at 150°C for extended periods without a noticeable change in the postirradiated values of the TCR or TCGF. (STAR)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 47186, 47397, 47505, 47565, 47566, 47578, 47621, and 47627.

47445 (BNL–12327) ROLE OF THE THYMUS IN THE ESTABLISHMENT OF IMMUNOLOGICAL COMPETENCE. Hess, M. W. (Bern Univ. (Switzerland). Theodor Kocher Inst.); Cottier, H. (Bern Univ. (Switzerland). Pathologisches Institut); Stoner, R. D. (Brookhaven National Lab., Upton, N. Y.). Mar. 14, 1968. 5p. (CONF-680311–1). Dep. CFSTI.

From 2nd International Congress of Lymphology, Miami Beach, Fla.

Indirect evidence for migration of a substantial number of lymphoid cells out of the thymus is presented; growth rate of the thymus was used. Also, the overall proliferative activity of thymic lymphoid cells during the same interval of perinatal life was estimated autoradiographically by studying the initial incorporation of tritium-labeled thymidine. Based on the data, it was estimated that at least one-third of the total number of lymphoid cells were newly produced in this 24 hour period (day 3 to 4). The increment in thymic weight gain during the same time interval was only 14 percent; therefore it was concluded that massive migration of cells out of the thymus and/or equally massive cell death accounted for the observed difference. Since extremely few pyknotic cells were found, the role of the thymus in the establishment and maintenance of immunological competence appeared to be established. (B.S.L.)

47446 (CONF-680503–3) MEASUREMENT OF TRITIATED ORGANIC COMPOUNDS IN THE PRESENCE OF TRITIATED WATER IN URINE. Pagnotto, Leonard D. (Massachusetts Dept. of Labor and Industries, Boston. Div. of Occupational Hygiene); Killian, Charles B. (New England Nuclear Corp., Boston, Mass.). [1967]. 23p. Dep.

From American Industrial Hygiene Conference, St. Louis, Mo.

A simple procedure is described for extracting tritium-labeled organic metabolites from urine using an alcohol-ether extracting solution. The extractant is evaporated to dryness, dissolved in alcohol, and analyzed for tritium. The procedure permits a separation of tritium-labeled organic metabolites and other soluble substances from tritiated water in urine. Once the tritium activity of these fractions is known, then the specific mode of metabolism of these substances can be employed more effectively in calculations of internal body dose. An application of the procedure is given for an accidental exposure from which a mixture of tritiated styrene and tritiated water was absorbed. (auth)

47447 (NYO–3445–15) EFFECT OF IONIZING RADIATION ON THE DISTRIBUTION OF DEOXYRIBONUCLEASES AND PHOSPHATASES IN SUBCELLULAR FRACTIONS OF GUINEA PIG EPIDERMIS. Fourth Year Progress Report, August 14, 1967–April 15, 1968. Tabachnick, Joseph (Albert Einstein Medical Center, Philadelphia, Pa. Lab. of Experimental Dermatology). May 13, 1968. Contract AT(30-1)-3445. 31p. Dep. CFSTI.

The data showed that the level of free DNAase I in the skin surface of the albino guinea pig increased rapidly after close clipping of hair with an electric shaver. There was an 8 to 30-fold increase by the 6th day and this reaction subsided by the 10th day. After 3000 rep β-irradiation of the clipped area, the increase in extracellular DNAase I as a result of irradiation was evident beginning about the 8th to the 10th day at the time when the first signs of an acute inflammatory response was evident. It reached peak levels from 25 to 200 times the "0" time value by the 2nd to 3rd weeks postirradiation and returned toward the "0" time level by the 30th day. Ulcerated, irradiated areas, however, retained a very high level of skin surface DNAase I at the 30th day probably due to release of enzyme from blood platelets. The biological significance of this phenomenon is not clear. It was believed that it may play some role in cell proliferation rather than cell death, since an increase in DNAase I activity was elicited by mild skin traumas such as clipping or plucking of hair which stimulated epidermal cell growth with little or no accompanying necrosis. In addition, the increase in extracellular DNAase I preceded or accompanied the epidermal hyperplasia during regeneration and repair following β-irradiation injury. The ability to demonstrate an increase in skin surface or extracellular DNAase I without removing epidermis and after clipping of hair or β-irradiation injury, strongly suggested that this enzyme was present in the interstitial compartment and on the skin surface. The increments in extracellular DNAase I observed in earlier experiments with excised epidermis reflected an increase in the enzyme in the interstitial compartment and on the skin surface; breakage of cells during handling played but a minor role in accounting for these increases. (auth)

47448 (PRNC–69) RESONANCE IN RADIATION EFFECTS. Technical Report No. 3. Luse, Robert A.; Koo, Frank S.; Paraskevoudakis, Peter; Martinez, Florencio Vazquez; Vidal, Baltasar Cruz (Puerto Rico Nuclear Center, San Juan). June 1965. Contract AT(40-1)-1833. 49p. Dep. CFSTI.

Using monochromatic X rays, molecules were irradiated at energies above and below the K absorption edge of selected target atoms. Damage was evaluated on the basis of effect observed per unit energy absorbed, or per photon absorbed, in the molecular system. It was shown that in carboxypeptidase A and in labelled chromosomes (5-bromodeoxyuridine), the efficiency of damage production was a sensitive function of the energy. Problems of technique in measuring the incident radiation and in producing high intensities of monochromatic radiation are also reported. Absolute measurements of photon fluxes in the energy range commonly used (5-15 keV) was difficult with available equipment. However, progress was made on a total absorption calorimeter that will make absolute measurements possible. In the search for appropriate systems to test the resonance hypothesis, two characteristics were desirable: (1) sensitivity to radiation so as to keep the required dose within the range of our equipment and (2) unambiguous evidence of radiation damage. The bacterium, Escherichia coli, was studied as a test system for evaluating the energy dependence of radiation damage. Preliminary studies on growth techniques and on radiation effects using ^{60}Co are reported. Research on effects due to monochromatic radiation in alkali halide crystals (KBr) is reported briefly in an appendix. (B.S.L.)

47449 (UCRL–50435) BARIUM ACCUMULATION BY ISOLATED RAT-LIVER MITOCHONDRIA. Grabske, Robert J. (California Univ., Livermore. Lawrence Radiation Lab.). May 2, 1968. Contract W-7405-eng-48. 11p. Dep. CFSTI.

Some of the characteristics of barium transport and certain comparisons between barium transport and calcium and strontium transport are presented. Barium ions were found to be actively transported by isolated rat-liver mitochondria and deposited as barium phosphate salts with a Ba/PO_4 ratio of 1.3. Associated with the uptake of barium was a release of H^+ with a Ba/H^+ ratio of 1.9. Barium transport was shown to be similar to the transport of strontium and calcium. Barium was accumulated at a rate equal to one-tenth that of calcium accumulation and did not induce mitochondrial swelling as did calcium. The presence of equal concentrations (1.0 mM) of calcium or strontium significantly reduced the uptake of barium. The binding of barium by polar side-chain groups of the mitochondrial proteins did not contribute significantly to the uptake of barium by the mitochondria. (auth)

47450 PSYCHIATRIC DIAGNOSIS, ACTIVATION, AND RADIOACTIVE IODINE UPTAKE. Blumberg, Arnold G.; Klein, Donald F. (Hillside Hospital, Glen Oaks, N. Y.). Arch. Gen. Psychiat., 18: 601–4 (May 1968).

In 222 hospitalized psychiatric patients, ^{131}I uptake determinations were made 24 hr after the administration of 50 to 100 μCi of carrier-free ^{131}I orally, by measurement of the mean thyroidal radiation at four geometric ports, using a 3 cm collimated scintillation probe. It was hypothesized that high ^{131}I uptake would be associated with psychomotor retardation, thus justifying a one-tailed test of significance. Correlational analysis showed no relation between ^{131}I uptake and age ($r = 0.01$) or sex ($r = 0.06$) in this sample. Distribution of mean uptake by diagnosis and activation status, as shown by analysis of variance comparing all diagnostic groups without regard to activation, yielded an insignificant F value. Comparison of activation subgroups showed an insignificant trend in the hypothesized direction ($t = 1.50$, $P < 0.10$, one-tailed) for retarded patients to have higher uptakes than normoactive patients. Retarded patients with the lowest ^{131}I uptake were diagnosed manic depressive cyclic, indicating prior manic episodes that could have affected thyroid function. The pseudoneurotic schizophrenics had a significantly lower uptake than all other patients considered schizophrenic. (BBB)

47451 EFFECT OF SOME PRETREATMENTS ON UV SENSITIVITY AND ON THE COURSE OF MACROMOLECULAR SYNTHESIS IN ESCHERICHIA COLI 15 T^-, U^-, his^-. Sedliakova, M.; Masek, F.; Brozmanova, J. (Inst. of Biology, Bratislava). Folia Microbiol. (Prague), 13: 118–24 (1968).

Sensitivity to uv radiation was studied in E. coli 15 T⁻, U⁻, his⁻ cells after 45-min glucose, thymine, uracil, or histidine preirradiation starvation, as well as the course of DNA, RNA, and protein synthesis during starvation and during 60 min post-treatment in a complete medium. Increased radioresistance was observed when starvation for some compounds resulted in a consequent inhibition of protein synthesis; it was observed with glucose, histidine, or uracil starvation. During thymine starvation, which led to decreased resistance, no inhibition of protein synthesis occurred. The postirradiation time-course of DNA synthesis did not show any correlation with the increased degree of resistance. DNA synthesis after uracil deprivation pretreatment was greatly delayed; however, after glucose pretreatment no retardation was observed although both factors increased the rate of surviving cells to the same extent. Factors that increase radioresistance may act by a similar mechanism that may take part in the inhibition of protein synthesis. This mechanism may entail a decrease of messenger RNA turnover. (BBB)

47452 FRACTIONAL COMPOSITION OF SERUM PROTEINS AT LONG TIMES AFTER CHRONIC EXPOSURE TO IONIZING RADIATION. Fokina, T. V.; Mikhalkina, F. G. (Inst. of Pediatry, Moscow). Radiobiologiya, 7: 846-9(1967). (In Russian).

Fifteen dogs were studied, eight of which were irradiated daily with 10 R starting on the fifth day of age, four starting at 1.5 months, with total doses of 1300 to 3980 R; and three dogs served as controls. When the irradiation was halted the animals were in the phase of temporary compensation; their general condition and their peripheral blood indexes differed little from those of the controls. Serious damage to the blood system developed over a period of three years and seven animals died. The albumin fraction decreased considerably and the gamma-globulin fraction increased. The total serum protein remained unchanged. (JPRS)

47453 ARSENIC ESTIMATION IN THE PRESENCE OF ^{74}As. Blanquet, P.; Croizet, J.; Croizet, M.; Castagnou, R. (Faculte de Medecine, Bordeaux). Ann. Pharm. Franc., 26: 159-61(Feb. 1968). (In French).

Radioactive ^{74}As was used in combination with a colorimetric method to determine As in toxicological studies. The colorimetric method, that of Martin and Floret, involved reaction of arsines with a pyridine solution of Ag diethyldithiocarbamate. Details of the technique were modified to improve the yield of activity in the final solution; eventually 97% transfer of activity was achieved. The chemical procedure called for reduction of the unknown with Zn and HCl or H_2SO_4, trapping with Pb acetate-soaked cotton, and solution in the pyridine solution of Ag diethyldithiocarbamate. Use of cotton rather than paper was recommended; the tracer studies suggested that the method could be employed in toxicological analyses; for samples between 1 and 100 μg yields ranged from 89 to 95%. (BBB)

47454 PHOTOCHEMICAL REACTIONS OF PHOTODYNAMICALLY ACTIVE FUROCOUMARINS. Krauch, Carl Heinrich (Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). Strahlentherapie, 136: 250-4(1968). (In German).

Because their activity was independent of temperature and oxygen, the fucocoumarins were basically different from the other color-substances with photodynamic activity. Extensive photochemical investigations disclosed some information concerning the reactivity of the fucocoumarins under the influence of ultraviolet light. With different methods it was shown that Psoralen reacted with DNA (RNA) under irradiation. The principal reagent was thymine (uracil). The photoproduct with uridine was separated by paper chromatography and again split into its original product by photochemical methods. The results showed that Psoralen reacted by cycloaddition with its 3 – 4 double bond on Thymine (uracil). (auth)

47455 INFLUENCE OF GAMMA IRRADIATION IN UTERO ON THE DEVELOPMENT AND FUNCTIONAL ADAPTATION OF SELECTED ENZYMES IN THE BEAGLE. Wagner, Murphy Thomas Jr. Fort Collins, Colo., Colorado State Univ., 1967. 176p. Thesis.

To establish the pattern for several adaptive enzymes during development of the beagle and to determine if irradiation during gestation would interfere with subsequent functional adaptation, variations in the radiosensitivity of developing enzyme systems with gestational age were investigated. A constitutive enzyme was studied for comparative purposes. Patterns of activity during development were established for the liver enzymes: glucose-6-phosphatase, α-glycerophosphate dehydrogenase, and glucose-1-phosphate uridyltransferase, and the kidney enzyme glucose-6-phosphatase. That the liver enzymes were adaptive while the kidney enzyme was of the constituitive type, was demonstrated by the use of Actinomycin D. The irradiated animals were exposed, in utero, to 250 R from a ^{60}Co source at either 8 or 28 days of gestation. Tissue collection and enzyme assays were made at 0, 4, 7, and 12 days of age. All enzyme activities were based upon protein content. It was shown that exposure to ionizing irradiation during gestation may decrease postnatal functional enzyme adaptation while the base levels of enzyme activity were unaffected. The constitutive enzymes were unaffected by in utero irradiation. It was further demonstrated that the period of gestation, when the irradiation exposure was made, was critical for each enzyme insofar as affecting the adaptive ability of that enzyme after birth. The findings indicated that irradiation in utero adversely affected the mechanisms of adaptation while unaffecting the synthetic mechanisms involved in maintaining enzyme levels. Further, these findings demonstrated that radiation damage to enzyme adaptive mechanisms, occurring during early prenatal development, could be carried through many cell generations, over an extended period of time, and amplified in such a manner as to be manifested in the young pup. (Disser. Abstr.)

47456 RADIOSENSITIVITY OF DEOXYRIBONUCLEIC ACID OF CHROMATIN. Weinert, Heide; Hagen, Ulrich (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie, 136: 204-12 (1968). (In German).

Deoxyribonucleoprotein was γ-irradiated (^{60}Co) as a wet gel at a concentration of 0.53 and 0.20. After irradiation, the DNA was separated from the protein. Single and double strand breaks, crosslinks, and the shift of the melting point were used as criteria for radiation effects in the DNA. Single and double strand breaks increased linearly with the dose. Ten times more single breaks were found than double breaks. Whereas double breaks were due to the primary ionization within the DNA molecule, single breaks were formed mostly by diffusible radicals formed in the water. There was no indication that crosslinks between DNA molecules occurred in the nucleoprotein gel. The mechanism of the radioinduced shift of the melting point was discussed. (auth)

47457 MUTAGENIC ACTION OF UV-IRRADIATED PSORALEN ON DROSOPHILA MELANOGASTER. Nicoletti, Benedetto; Trippa, Giovanni Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 43: 259-63(Sept.-Oct. 1967). (In Italian).

Psoralen, a photodynamic furocumarine, was tested for mutagenic effects on Drosophila males, fed or injected with the substance and irradiated with uv light (λ3655 Å). The treated spermatozoa bearing a yw marked X chromosome were tested with the M-5 method for sex linked recessive lethals. Mutations occurred after feeding uv-irradiated psoralen; unirradiated psoralen resulted in fewer mutations. The F_2 results showed that ingested psoralen could induce sex linked lethal mosaics. The salivary chromosome analysis of females heterozygous for the X chromosomes bearing psoralen-induced lethals did not show structural rearrangement. (auth)

47458 IMPROVEMENT OF A RESEARCH TECHNIQUE IN THE CONTAMINATION OF THE BEE LABELED WITH A RADIOISOTOPE. Donault, P. (Station de Recherches sur l'Abeille et les Insectes Sociaux, Bures-sur-Yvette, France). Ann. Abeille, 9: 165-9(1966). (In French).

Radiation effects as well as radioisotope labeling techniques are reported in relation to the contamination of bees. A cellophane tube was prepared of suitable size for the living bee. The radioisotope used, ^{32}P, and incorporated in the bee's food, had a half-life of 14.3 days and emitted β radiation of 1.707 MeV energy. The bees were counted in cellophane tubes. Radiation absorption of the cellophane was 2.5% on the average. Cotton was used to block both ends of the tube. Counting was done with a G-M well-type counter, first with one side of the bee toward the detector, then the other side. After the experiment, which could be continued for several days, the bee recovered quickly. In the ten lots of bees used, only one bee died. Furthermore, no ill effects were observed in the bees. It was concluded that the described technique is a safe and efficient method for labeling and counting bees and for other insects as well. (BBB)

47459 NATURE OF THE PARAMAGNETIC CENTRES OF IRRADIATED PROTEINS INTERACTING WITH OXYGEN. Aripova, D. F. (Inst. of Biological Physics, Pushchino-on-Oka, USSR). Biophysics (USSR) (Engl. Transl.), 12: 1131-40(1967). Translated from Biofizika, 12: 989-96(1967).

The effect of oxygen on free radicals of pepsin irradiated with ultraviolet was investigated. It was established that on exposure to oxygen at a temperature above 153°K peroxide free radicals form in the irradiated proteins. Appearance of a peroxide EPR signal on admission of oxygen to protein with a doublet EPR signal leads to an increase in the total concentration of unpaired electrons, the number of peroxide radicals formed corresponding to the number of unpaired electrons that have passed into the "hidden" state as a result of heating in oxygen-free conditions; from this it was assumed that the peroxide EPR signal appears not as

a result of the transformation of the doublet EPR signal but as a result of those free radicals that have ceased to be recorded after preliminary heating in vacuo. The wide singlet signal obtained in the first minute after admission of oxygen at room temperature to the preparation with a doublet signal is the sum of the doublet EPR signal and the peroxide signal. Narrowing of the signal on interaction with air at room temperature is due to gradual reduction in the doublet signal in relation to the peroxide signal. The narrow singlet signal ($\Delta H = 13 \pm 1$ oersted) with a g factor close to that of the free electron measured a few hours after the action of oxygen on anaerobically irradiated protein constitutes in the main the peroxide EPR signal. (auth)

47460 LONG-TERM RETENTION OF ^{137}Cs IN THE RAT. Thomas, R. G.; Thomas, R. L. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys., 15: 83-4(July 1968).

The longest component reported for ^{137}Cs retention in humans is in the range of 100 to 200 days; a longer phase has been postulated, but there is no concrete evidence to substantiate its existence. A similar situation prevailed with the rat, in that the longest component reported following injection had a half-life of less than 20 days. Studies are described which indicate a small fraction of initially deposited ^{137}Cs that is excreted at a much lower rate than observed previously, and which may be analogous to the long component predicted for humans. Limited tissue analyses indicate that this long-term component of whole-body retention is primarily a reflection of localization in the skeleton. (auth) (UK)

47461 ON THE CONCENTRATION OF RADIOACTIVITY ON THE PART OF SOME ALGAE. Branca, G.; Paoletti, A. Ig. Sanita Pubblica, 20: 360-70(Sept.-Oct. 1965). (In Italian).

Research was carried out to establish the behavior of a number of freshwater algae with respect to ^{90}Sr, ^{137}Cs and ^{106}Ru using unialgal cultures. Forms showing a greater reproduction rate and a higher concentration factor for radioisotopes were determined in order to study the possibility of using the algae as a finishing treatment for waste waters containing radioisotopes. It was concluded that the uptake of ruthenium by algae was very large while the accumulation of cesium was lower. (auth)

47462 TUMOR IMMUNOLOGY. Bergheden, C. (Karolinska Inst., Stockholm). Nord. Med., 76: 1173-9(Oct. 13, 1966). (In Swedish).

Radiobiology experiments are described in a review of specific tumor antigens. By various methods, tumor-specific antigens have been demonstrated in different kinds of tumors in animals. In tumors caused by viruses the same antigens are found in different tumors induced by the same virus. In chemically and physically induced tumors, however, each individual tumor possesses its own specific antigens. If mice are injected with in vitro x-irradiated tumor cells (induced by Moloney virus or methylcholanthrene), they become immunized and relatively tumor resistant. The superficial localization of the antigens makes it possible to kill the tumor cells with antibodies and cell-bound immunity. The use of immunotherapy of tumors requires further experimental studies on animals. The experience thus gained can then be applied to tumors in man, provided that such tumors can be definitely proved to be antigenic, which has not yet been demonstrated. (BBB)

47463 INACTIVATION OF TRANSFORMING DNA BY TRITIUM DISINTEGRATIONS IN VIVO. McCarthy, Charlotte; Nester, Eugene W. (Univ. of Washington, Seattle). Biochim. Biophys. Acta, 166: 249-50(Aug. 23, 1968).

To determine whether the radiation resulting from tritium in protein damages DNA and whether amino acid-incorporated tritium kills less efficiently than thymidine-incorporated tritium because of the greater distance from DNA, a comparative study was performed by direct assay of the biological activity of transforming DNA isolated from Bacillus subtilis that had incorporated tritium-labeled thymidine (^3H-TdR) or amino acids (^3H-AA) (histine or leucine) and had undergone suicide to varying degrees. Transforming activity was lost in DNA extracted from cells that underwent either ^3H-TdR or ^3H-AA suicide. The loss of transforming activity demonstrated single-hit kinetics; the decrease in viable cells also followed single-hit kinetics. Regardless of the tritium-labeled compound used, the loss of biological activity of extracted DNA was proportional to the loss of survival. It was concluded that the basic cause of death was independent of the macromolecule that contained the tritium and that death from tritium resulted in activation of the genome by ionizing radiation. (B.S.L.)

47464 TRANS-SYN THYMINE DIMERS IN ULTRAVIOLET-IRRADIATED DENATURED DNA: IDENTIFICATION AND PHOTOREACTIVABILITY. Ben-Hur, E.; Ben-Ishai, R. (Israel Inst. of Tech., Haifa). Biochim. Biophys. Acta, 166: 9-15(Aug. 23, 1968).

A new thymine-derived minor photoproduct was identified from denatured DNA irradiated with ultraviolet light. On the basis of its chromatographic properties, acid stability, and photoreversal to thymine, it was postulated that this photoproduct is identical with the trans-syn cyclobutane thymine dimer. Yeast photoreactivating enzyme in the presence of light did not monomerize the trans-syn thymine dimer; it eliminated, however, specifically and almost completely the cis-syn thymine dimer isomer from irradiated denatured DNA. (auth)

47465 MEDICAL AND DENTAL USE OF LASER. REPORT I. EFFECT OF LASER ON HARD TISSUE. Furumoto, Keiichi; Katada, Susumu (Nippon Dental Coll., Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 229-39(June 1968). (In Japanese).

The effect of ruby laser (6 joules output and 1200 joules/cm^2 energy density) on dental hard tissue and soft tissue and on coloring resins was investigated for elucidation of the essential qualities of its action and amassing of basic data for clinical application. As microscopic view of laser impact on biological materials was classified in defect and charring, a bigger influence was exerted over dentin rather than enamel in the teeth, the effect probably being mainly a thermal action. The main effect on bones was presumed to be that shock wave action existed besides the thermal action. A weakening change on the surface layer of the tongue of the mouse was noted; hemorrhagic foci were noted in depth. In soft tissue, the effect was presumed to be a shock wave action and biological reaction rather than a thermal one. In the coloring resins, the biggest influence was exerted over the green resins that were the complementary color of the ruby laser. In the case of transparent and opaque resins, an internal change was mainly noted in the former and an external one in the latter. (NSA of Japan)

47466 X-RAY INDUCED INACTIVATION OF BRADYKININ. Sturde, Hans-Carl; Heitmann, Hans-Joachim (Ruhr-Univ., Bochum, Ger.). Strahlentherapie, 136: 213-19(1968). (In German).

Results of experimental investigations on x-radioinduced inactivation of bradykinin in aqueous solution were presented. A significant decrease in the biological activity of bradykinin was found, using the surviving isolated terminal ileum of guinea-pigs. It appeared that the remaining biologically active bradykinin decreased with increasing radiation dose (1000 bis 8000 R). Investigations with bradykinin in frozen water and bradykinin in Tyrode-solution or 0.9%-NaCl-solution demonstrated no changes in activity after exposure to x irradiation (protection effect). Experiments with different concentrations of bradykinin dissolved in water revealed different radiation-effects. There was a remarkable influence of temperature (+4°C and +56°C) in the radiochemical reactions. Finally the results were discussed in connection with the target-theory. (auth)

47467 STUDY OF IRRADIATED INTERFERON BY BIOLOGICAL AND EPR METHODS. Bostandzhyan, M. G.; Balezina, T. I.; Vilenchik, M. M.; Korabel'nikova, N. I.; Kalmanson, A. E. (Inst. of Virology, Moscow). Biophysics (USSR) (Engl. Transl.), 12: 1252-3(1967).

Translated from Biofizika, 12: 1092-3(1967).

The course of accumulation of free radicals in γ-irradiated interferon was studied with parallel investigation of its antivirus activity. No loss of antivirus activity was caused by irradiation, nor was there a toxic action of the irradiated preparations on the cells in chick fibroblast tissue culture. (M.C.G.)

47468 BEHAVIOR OF ^{239}Pu IN YOUNG PIGS. Buldakov, L. A. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 62-4 (1968). (In Russian).

The distribution of 1% citric acid solution of ^{239}Pu (pH = 6.5) was investigated after intravenous administration of 3 μCi to 15 young pigs 2.5 months old and weighing 10 to 12 kg, 33 μCi were administered perorally. Animals from the first group were killed in groups of three on 1, 9, 65, 330 and 640 days after injection and those of the second group on the day after administration. The absorption of plutonium citrate was 0.19% in the intestines and 87% of the resorbed portion of the Pu was retained in the skeleton. The maximum content in the spongy bones was only three times (after intravenous injection, three to ten times) as much as in the compact parts of the skeleton. The Pu concentration in the bones was three to ten times as large as in the soft tissues (excluding muscles) after peroral and 20 to 100 times as large after intravenous administration. (JPRS)

47469 REDISTRIBUTION IN THE SYNTHESIS OF NEWLY FORMED RNA FRACTIONS AFTER IRRADIATION. Tokarskaya, V. I.; Umanskii, S. R. (Inst. of Biophysics, Pushchino-na-Oke, USSR). Radiobiologiya, 8: 101-6(1968). (In Russian).

Unsprouted germs of the seed of the radiosensitive pea variety Pobeditel, both dry and after being soaked in water for four hours, received a dose of 20 kR at 700 R/min (^{137}Cs). In the first series of experiments the seeds were again moistened after irradiation

and the germs were removed and again exposed for 20 min, 4 hr and 16 hr in inorganic phosphate ^{32}P solution. In the second series, 7-day sprouts were exposed in a sealed chamber in a $^{14}CO_2$ atmosphere; the high-polymer RNA was separated by means of sodium dodecylsulfate at pH = 5.0 and then treated with DNAase. The DNAase was then separated and the RNA analyzed chromatographically; the composition of the RNA fractions tagged with ^{32}P was determined after alkaline hydrolysis and electrophoresis on the basis of the radioactivity of the 2',3',mononucleotides. A redistribution of the synthesis of the RNA fractions was found. After irradiation the synthesis of RNA with an AU type of nucleotide composition decreased and the rate of synthesis of ribosomal RNA increased. (JPRS)

47470 IODINATION OF ANGIOTENSIN II. Osborn, E. C. (Welsh National School of Medicine, Cardiff, Wales). J. Pharm. Pharmacol., 20: 399-400(May 1968).

Deficiencies in methods of radioiodination of angiotensin II, for use in radioimmunoassay were pointed out, and an improved method was reported. Investigation of the efficiency of the radioiodination method of Hunter and Greenwood showed that, using 5 μg of angiotensin II and 1 mCi of Na ^{131}I in the reaction mixture, only about 1% of the angiotensin molecules were radioiodinated. The radioiodinated angiotensin migrated much more slowly towards the cathode (0.2 cm/hr compared with 1.5 cm/hr) than native angiotensin. The radioiodinated angiotensin could be readily eluted from the paper with methanol. Because of previous reports concerning the loss of the biological activity of radioiodinated angiotensin II the effect of modifying the method of Hunter and Greenwood for radioiodinating synthetic angiotensin II was also investigated. Excess iodine was used in place of excess chloramine T, sufficient iodine being liberated from the NaI to ensure complete iodination. The iodinated derivative was eluted after electrophoresis. (BBB)

47471 INFLUENCE OF ^{237}Np ON THE ACTIVITY OF CERTAIN ENZYMES OF PHOSPHORUS METABOLISM. Kreslov, V. V. (Inst. of Biophysics, Kiev). Radiobiologiya, 8: 30-3 (1968). (In Russian).

Female rats of the Wistar line with a starting weight of 160 to 170 g received one intravenous injection of ^{237}Np in nitric acid solution at pH of 2.0 at a dose of 1 μCi (1.5 mg) per rat. The activity of alkaline and acid phosphatases and ATP-ase was investigated 1, 3, 7, 14 and 30 days later in the liver and kidney tissues. In the kidneys the activity of alkaline phosphatase was 50% of the control level a day later and about 20% after two weeks when it rose; it was still below the control levels after a month. The acid phosphatase activity decreased 30% in the first days and remained at that level for one month. In the liver the activity of both the alkaline and acid phosphatases decreased almost 50% in the first days, then gradually increased to the level of the controls. Neptunium-237 did not affect the ATP-ase activity of the kidneys in over a one-month period; in the liver the activity tended to increase in the first two weeks and return to normal after a month. (JPRS)

47472 METABOLISM OF ^{90}Sr IN GROWING RATS AS A FUNCTION OF AGE AND THE STATE OF CALCIUM METABOLISM. Dubrovina, Z. V.; Sarapul'tsev, I. A. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 40-5(1968). 22(In Russian).

The offspring of female rats of the Wistar line that had received rations with identical ^{90}Sr activity (~2.5×10^{-8} Ci animal day) but with different calcium levels, when weaned, received the mother's ration but in a smaller quantity that was increased 10% every 10 days. Calcium (Ca^{++}) was added in the form of the chloride. Some animals received $^{90}SrCl_2$ with $CaCl_2$ and some animals $^{90}SrCl_2$ with $^{45}CaCl_2$, administered once per os through a probe, or intraperitoneally a day before they were killed; numerous groups of five to seven rats were killed during the experiment. Group I received 40%, group II 100% and group III 220 to 230% of the normal calcium level. The P content was identical in all groups and corresponded to the normal physiological requirement (Ca : P ratios of 1 : 15, 1 : 0.75 and 1 : 0.3 respectively). The results showed that the only acceptable method of calcium protection was strict observance of normal calcium feeding. The weight of the rats increased linearly during the experiment, but whereas the weights of rats of groups I and II were practically the same, rats of group III lagged considerably in weight and had a noticeably poorer appearance. (JPRS)

47473 DISTRIBUTION AND BIOLOGICAL EFFECT OF ^{241}Am. Zalikin, G. A.; Moskalev, Yu. I.; Petrovich, I. K. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 65-71(1968). (In Russian).

Americium-241 was administered in the form of the chloride intravenously and intratracheally (0.5 and 0.3 ml respectively, 2 μCi/l) and perorally (1.0 ml, 2 and 19 μcuries/l) to white rats weighing an average of 200 g. At certain intervals the rats were killed and samples taken from the organs and tissues for determination of γ radiation as percent of the introduced activity. After intravenous administration ^{241}Am rapidly accumulated in the liver (about 57%) and skeleton (about 18%); high accumulations were noted in the kidneys (1.1%), liver (7.1%), bones (1.41%), spleen (0.65%), thyroid gland (0.43%), adrenal glands (0.18%) and ovaries (0.13%). After intratracheal administration it was slowly absorbed from the lungs; the effective period of half-excretion of the excreted portion was 66 days. In peroral administration not more than 0.03% was absorbed from the gastrointestinal tract. For ^{241}Am administered intravenously in the form of the chloride the acute $^{15}LD_{50}$ and $^{30}LD_{50}$ and subacute $^{120}LD_{50}$ were 0.14, 0.11, and 0.04 μCi, respectively. (JPRS)

47474 PROTECTION AGAINST HOMOLOGOUS DISEASE BY IMMUNOLOGIC FACILITATION (ENHANCEMENT PHENOMENON) INDUCED PASSIVELY AND ACTIVELY. Voisin, G. A.; Kinsky, R.; Maillard, J. (Hopital Saint-Antoine, Paris). Ann. Inst. Pasteur, 113: 521-47(Oct, 1967). (In French).

It was shown earlier than the enhancement phenomenon was not limited to homografted tumors and that it can exert a protective effect upon newborn mice against runting disease induced in them by allogenic lymphoid cells. Both passive and active immunological enhancement procedures gave comparable results. The experiments described here deal with wasting disease induced in adult hybrid mice of the type $(B \times A)F_1$ by an injection of B parental spleen cells. The object was to reduce the rates of mortality from wasting disease by using enhancement-facilitation procedures of both the passive and active type. In most experiments serums showed good results in reducing mortality. X-irradiated cells were used in some experiments. Passive enhancement-facilitation of $(B_{10}D_2 \times CBA)F_1$ hybrids receiving $B_{10}D_2$ spleen cells, by an anti-CBA $B_{10}D_2$ serum, reduced mortality from 87% to 60%. This effect was removed by specific absorption of the active immune serum. Active enhancement-facilitation displayed clearly its effect in the same strain combination and also in the $C_{57}BL_6 \rightarrow (C_{57}BL_6 \times CBA)F_1$ combination, where specificity of the phenomenon was controlled in hybrids receiving cells from parental donors immunized with extracts of lyophilized guinea-pig tissues; this procedure did not result in the same enhancing-facilitating effect. In the $B_{10}D \rightarrow (B_{10}D_2 \times CBA)F_1$ strain combination, the preimmunization of $B_{10}D_2$ cell donors with living x-irradiated (11,000 R) CBA cells did not produce an enhancing-facilitating effect, but resulted in an aggravation of the disease, sometimes limited to the decrease in lymphocyte blood counts. This was seen also in the $B_{10}D_2 \rightarrow (B_{10}D_2 \times A)F_1$ strain combination even with lyophilized immunizing antigen. (BBB)

47475 UPTAKE OF RADIOACTIVE IODINE BY THE THYROID AFTER PINEALECTOMY, Csaba, G.; Kiss, J.; Bodoky, Marta (Medical Univ., Budapest). Acta Biol. Acad. Sci. Hung., 19: 35-41(1968).

The incorporation of ^{131}I by the thyroid gland of rats subjected to removal of the pineal gland and sham-operated controls was studied. Both adult rats and three-week-old rats were pinealectomized. The ^{131}I uptake per unit of thyroid gland weight increased in all rats that were pinealectomized as adult animals. The increase was more than 50% of the original value and statistically significant. The 24-hr urinary output of ^{131}I in the control group was considerably in excess of that registered in the test group, but the difference was not statistically significant. Disappearance of ^{131}I from the blood showed no significant difference between the various groups. Values for pinealectomized animals were intermediate between those of the controls and those of the sham-operated group. Differences disappeared after 24 hr. There was no essential difference between the radioiodine uptake of untreated controls and that of sham-operated animals. (BBB)

47476 RADIATION-INDUCED HYBRIDIZATION OF PROTEINS. Radola, Bertold J. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Biochim. Biophys. Acta, 160: 469-72(Aug. 13, 1968).

When mixtures containing human serum albumin and sperm-whale myoglobin, previously purified by gel filtration to obtain the monomer, were γ-irradiated (^{60}Co) under N_2 in a 0.02M phosphate buffer (pH 7.2) at 0°, a new electrophoretic pattern appeared on paper electrophoresis. Evidence presented indicated that this fraction consisted of albumin-myoglobin hybrids; hybrids is defined. With increasing doses increased quantities of the hybrid appeared, while both the myoglobin and albumin decreased; however, the albumin was removed first from the reacting mixture. It was concluded that radiation hybridization appeared to be a phenomenon of general occurrence not limited to only a few proteins and that it did not involve intermolecular disulfide bonds since the myoglobin and protamines used did not contain cystine or cysteine. (B.S.L.)

47477 THE EFFECT OF DEUTERIUM OXIDE ON RESPIRATORY-CHAIN PHOSPHORYLATION IN SUB-MITOCHONDRIAL PARTICLES. Muraoka, S.; Slater, E. C. (Univ. of Amsterdam). Biochim. Biophys. Acta, 162: 170-4(Aug. 20, 1968).

The P:O ratio of sub-mitochondrial particles prepared by sonication at pH 8.6 was stimulated by both ^2H_2O and by oligomycin. The stimulations were approximately equal and were additive. The stimulatory effect of ^2H_2O was also additive to that of F_1-X. The P:O ratio of sub-mitochondrial particles prepared by sonication at pH 7.4, which was not affected by low concentrations of oligomycin, was also stimulated by ^2H_2O. The increase in the P:O ratio brought about by ^2H_2O was primarily caused by an inhibition of the oxygen uptake. Phosphorylation was either not affected, or was little affected. The results support the view that the hydrolysis of an intermediate of oxidative phosphorylation was slower in ^2H_2O than in H_2O. If this interpretation of the effect of ^2H_2O is correct, it would seem unlikely that the stimulatory effects of oligomycin and F_1-X were due to inhibition of the hydrolytic reaction that is affected by ^2H_2O. (auth)

47478 CHROMOSOMES AND CELLULAR RADIOSENSITIVITY. III. NOTE ON THE INABILITY TO DEMONSTRATE A CORRELATION BETWEEN NUCLEIC ACID BASE RATIOS AND RADIATION RESPONSE AT D_0 IN SEVERAL DIVERSE ORGANISMS. Underbrink, A. G.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 35: 311-17(1968). (BNL-11910).

Nucleic acid base composition values and D_0 values were assembled and plotted for 50 organisms, mostly viruses and bacteria. A possible correlation may exist between these variables, but only for a few organisms. Base composition is probably not an important factor in determining the radiosensitivity of intact cells of various types of organisms. (auth)

47479 LABELING OF PERICYCLE CELLS WITH ^{3}H-THYMIDINE. Davidson, D.; MacLeod, R. D.; Webster, P. L. (Case Western Reserve Univ., Cleveland). Naturwissenschaften, 55: 351-2(July 1968). (COO-1625-14).

To determine whether the delay or failure to incorporate tritium-labeled thymidine (^{3}H-TdR) was initiated in the pericycle cells or whether this characteristic was acquired over a number of mitotic divisions, i.e., as the small primordia develop from groups of pericycle cells, whole roots of Vicia faba were grown for up to two hour in ^{3}H-TdR and autoradiographic studies carried out. It was found that pericycle and primordial cells incorporated little exogenous ^{3}H-TdR initially and that there was a gradual rise in labelling index over a period of 12 to 24 hr with or without continuous exposure to thymidine. It was concluded that not all pericycle cells in S-phase at the time of treatment with ^{3}H-TdR incorporated it into the DNA; it appeared that this characteristic was initiated in pericycle cells and transmitted to their descendents as they formed small primordia. (B.S.L.)

47480 RADIATION CHEMICAL PROPERTIES OF DNA. Sharpatyi, V. A.; Kruglyakova, K. E.; Nikolaeva, N. V. (Inst. of Chemical Physics, Moscow). Radiobiologiya, 8: 3-6(1968). (In Russian).

The yields of radicals obtained in the irradiation of 0.2% frozen and liquid aqueous solutions of DNA and dry preparations of DNA were determined by the EPR method. It was found that the yields resulting from the indirect action of radiation (in liquid solutions) were larger by one order of magnitude than those from the direct action (in frozen solutions and dry samples). (JPRS)

47481 CYTOCHEMICAL INVESTIGATION OF THE GLYCOGEN OF ELEMENTS OF THE THROMBOCYTIC SYSTEM UNDER THE EFFECT OF IONIZING RADIATION ON THE ORGANISM. Traskunova, N. V. (Central Scientific Research Roentgeno-Radiological Inst., Leningrad). Radiobiologiya, 8: 55-7(1968). (In Russian).

Forty-four rabbits of both sexes weighing 2.5 to 3.0 kg received a dose of 600 R of x irradiation at 17 to 17.6 R/minute. The peripheral blood and specimens of bone marrow obtained by puncture were investigated 1 hr and 1, 3, 7, 12, 15, 20 and 30 days after irradiation. A sharp reduction in the glycogen level was observed. The impoverishment of the megakaryocytes in glycogen occurred in parallel with the development of thrombocytopenia in the peripheral blood. Application of stimulators of thrombocytopoiesis permitted preserving some predominance of glycogen-containing megakaryocytes in the experimental animals as compared with animals only irradiated. One way by which pharmacological and hormonal agents can influence thrombocytopeisis of irradiated animals is by action on the intracellular metabolic processes of the megakaryocytes. (JPRS)

47482 STUDIES ON CHANGES INDUCED BY INTERNAL IRRADIATION ON FATTY ACID COMPOSITION OF ORGANS AND SERUM. PART I. CHANGES IN THE LONG-CHAIN FATTY ACIDS OF THE RABBIT INDUCED BY A RELATIVELY SMALL QUANTITY OF ^{32}P-LABELED PHOSPHATE. Katsumata, Naomi (Okayama Univ., Japan). Okayama Igakkai Zasshi, 79: 167-73 (Apr. 1967). (In Japanese).

To study changes in the composition of the long-chain fatty acids induced by ^{32}P β-irradiation internally, 500 μCi/kg of $Na_2H^{32}PO_4$ were injected intravenously into normal rabbits. The internal organs and serum were sampled at intervals of 24, 48, and 72 hr after the injection, and their fatty acid composition studied by gas chromatography. It was found that the distribution of ^{32}P in the organs was in the following descending order: liver, kidney, spleen, and bone marrow. The fatty acid composition in each of these organs as well as of the serum was affected by β irradiation at a relatively low dose. A rhythmic fluctuation was noted in the composition of some fatty acids (e.g., $C_{18:2}$) that was specific to each organ. It was difficult to determine the changes in the composition of the long-chain fatty acids induced by ^{32}P-labeled phosphate simply on the basis of gas chromatography conducted at any single time interval. (BBB)

47483 STUDIES ON CHANGES INDUCED BY INTERNAL IRRADIATION ON FATTY ACID COMPOSITION OF ORGANS AND SERUM. PART II. EFFECT OF X IRRADIATION ON THE FATTY ACID COMPOSITION IN THE MICE TRANSPLANTED WITH SOLID EHRLICH CARCINOMA. Katsumata, Naomi (Okayama Univ., Japan). Okayama Igakkai Zasshi, 79: 175-80(Apr. 1967). (In Japanese).

To study the effect of x irradiation on the composition of fatty acids in cancer-bearing animals, solid Ehrlich carcinomas were transplanted into the right leg of mice and then 500 R/day doses of x rays were given on the right leg of the animals consecutively for 10 days (total dose, 5000 R). The animals were divided into three groups, irradiated cancer bearing mice, nonirradiated cancer-bearing mice, and normal controls. Fatty acids extraction was carried out by the method of Folch in the tumor and right leg muscle, serum, and liver of each group, and the determination of the fatty acid composition was made by gas-liquid chromatography. It was found that the tumor tissue of the irradiated group contained a greater quantity of linoleic acid than that of the nonirradiated cancer-bearing group. The solid Ehrlich carcinoma of the right leg contained a larger amount of stearic acid than that in the right leg muscle of normal mice. As for the composition of total fatty acids in the liver and the serum, the percentage of linoleic acid was greatest in the control group of normal mice, followed by irradiated tumor bearing mice and nonirradiated tumor-bearing mice, in that order. There appeared to be some correlation between the inhibition of tumor growth by irradiation and the distribution of linoleic acid. (BBB)

47484 QUANTITY OF IMMUNOCOMPETENT AND COLONY-FORMING UNITS IN MOUSE SPLEEN AT DIFFERENT TIMES AFTER IRRADIATION. Kozlov, V. A.; Seslavina, L. S. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 72-8(1968). (In Russian).

Mice of inbred SVA line were irradiated with cobalt γ rays at a dose of 600 R (approximately $^{30}LD_{50}$) and investigated 1, 7, 30 and 60 days later. Maximum suppression of antibody formation was observed after 1 and 7 days; it was partially restored after 30 days, but even after 60 days the number of immunocompetent cells in the spleen was only 59 and 46% of the controls. The quantity of colony-forming units was sharply reduced after 1 and 7 days; after 30 days it was 103% in terms of 10^7 cells of the spleen and 63% in terms of the entire organism. (JPRS)

47485 X IRRADIATION OF THE HOMOLOGOUS CORNEAL DONOR MATERIAL. Narain, L.; Basu, P. K. (Univ. of Toronto, Can.). Can. J. Ophthalmol., 2: 54-7(Jan. 1967).

It was observed previously that bovine corneal donor tissues exposed to high doses of x irradiation (500 to 2000 R) and subsequently grafted in rabbits' corneas, produced a more intense reaction than that elicited by similar nonirradiated tissues. The irradiated donor cornea cytologically revealed abnormal cells and chromosome aberrations. These cellular changes could be caused by increased antigenicity of the grafted materials. If so, an intense graft reaction would be expected with irradiated homologous corneal donor tissue. This study was undertaken to test this hypothesis using freshly enucleated adult rabbit eyes. In each animal, one cornea was x-irradiated in single doses of 2000, 4000, and 8000 R (experimental donor tissue) and the other cornea was left untreated (control donor tissue). Each recipient rabbit received grafts of one irradiated corneal disc in the right eye (experimental eye) and one nonirradiated disc in the left eye (control eye), both grafts coming from the same donor. Before transplantation, the experimental and control donor tissues had similar appearance histologically. In vitro, both types of tissue demonstrated cellular outgrowths. In contrast to the control

donor tissue, the irradiated tissues showed abnormal cells and chromosome aberrations. Postoperatively, all grafts in the experimental and control eyes of the three dose groups remained clear and did not show any reaction in the hosts' eyes up to an observation period of four months. Histological studies revealed no significant differences between the experimental and control eyes of the recipient animal. It was concluded that the irradiation of homologous donor corneas had not enhanced a graft reaction, nor did it affect the postoperative clarity of the graft. (BBB) (TSS)

47486 TOLERANCE OF ALLOGENIC HEMATOPOIETIC CHIMERAS. Amiel, J. L. (Hopital Paul-Brousse, Villejuif, France). Ann. Inst. Pasteur, 113: 491-508(Oct. 1967). (In French).

The immunogenic phenomenona in hematopoietic chimeras are discussed in terms of three groups: general nonspecific immunogenic deficiency, reciprocal reaction between the recipient and the allogenic hematopoietic graft, and specific tolerance of the hematopoietic chimeras for the bone marrow donor's tissues. Whole-body irradiation is generally used for preparation of the recipient to produce hematopoeitic chimeras, and in the experiments described 800 R x irradiation was administered. In the allogenic radiochimeras, the immunogenic deficiency is related to three factors; depression of the recipient's immunogenic reactions by its adaptation to the graft, destruction, by the graft-vs-host reaction, of the immunologically competent cells of the recipient that had survived irradiation, and destruction of the graft's competent cells probably by antigen in excess from the recipient. Such immunogenic deficiency results in greater susceptibility to infections. Features observed in the radiochimera included the persistence of the graft's myeloid and lymphoid cells, and a reaction of the graft against the host, a reaction that may be followed by a specific tolerance of the graft's cells towards the recipient's antigens. The specific tolerance by the hematopoietic chimera of the transplants from the bone marrow donor exists only if the allogenic hematopoietic graft entirely overgrows the recipient's myelolymphoid tissues. (BBB)

47487 ^{132}I 3-HR. THYROID UPTAKE IN PREGNANT WOMEN AT EARLY GESTATION AND AFTER ARTIFICIAL ABORTION. Gorowski, T.; Jaroszewicz, B.; Chomicki, O.; Gaudyn, Janina (Postgraduate Medical School, Warsaw). Gynaecologia, 162: 206-12(1966).

The effect of pregnancy and subsequent induced abortion on incorporation of radioiodine by the thyroid gland was studied in 38 women. Direct evaluation of the thyroid function in pregnant women with radioiodine was not commonly done because of harmful effects to the fetus by ionizing radiation. To determine the thyroid radioiodine uptake ^{132}I was used; the half-life was 2.4 hr, and the exposure dose was $^{1}/_{10}$ that of the corresponding amount of ^{131}I. The tests with ^{132}I could be repeated several times, due to lower irradiation exposure (a lower dose than that from routine x-ray examination). The 3-hr thyroid ^{132}I uptake was determined in multiparas at early gestation and 24 hr after artificial abortion. Thyroid radioiodine uptake was also determined in 35 nonpregnant patients for comparison. The effect of curettage in 22 nonpregnant women on the changes of thyroid radioiodine uptake was estimated. Results showed that the thyroid radioiodine uptake was increased between 7th and 12th week of gestation. A considerable decrease in the radioiodine uptake 24 hr after artificial abortion, performed between 7th and 12th week of pregnancy, was noted in 55.3% of the cases. The initial thyroid radioiodine uptake was, on the average, higher in pregnant women in whom a considerable decrease was found 24 hr after artificial abortion than that in those showing no decrease. (BBB)

47488 QUESTION OF THE PERMEABILITY AND CONNECTION OF ^{35}S-LABELED CYSTEAMINE WITH COMPONENTS OF THE SPERM CELL OF MISGURNUS FOSSILIS. Vinogradova, I. D.; Faleeva, Z. N.; Shekhtman, Ya. L. (Inst. of Biological Physics, Moscow). Radiobiologiya, 8: 34-9(1968). (In Russian).

Sperms of Misgurnus fossilis were incubated with ^{35}S-labeled cysteamine and their activity was measured after they were washed five times with physiological solution. The cells retained some of the introduced activity. Much of the activity was not strongly connected with the DNP of the cells and was readily liberated during water shock and first extraction of the nucleoprotein, but a small portion of a stronger complex of the protector with the DNP of the sperm cell existed that was not destroyed even during repeated treatment of the nucleoprotein. (JPRS)

47489 THE RELATIONSHIP OF HYPOXIA TO THE EFFECTS OF X RADIATION ON RIBONUCLEIC ACID SYNTHESIS IN THE LIVER OF TRITURUS VIRIDESCENS. Witcofski, Richard Lou. Winston-Salem, N. C., Wake Forest Coll., 1967. 112p. Thesis.

The presence of oxygen in cells and tissues, at the time of irradiation, with few recorded exceptions throughout the plant and animal kingdoms, increases the magnitude of the effects of radiation. This interaction between oxygen and radiation is known generally as the oxygen effect. This study was an attempt to investigate whether there was an oxygen effect in a synthetic process in the cells of a vertebrate; namely whether synthesis of ribonucleic acid (RNA) would be equally affected by x radiation when the animals were irradiated either in a normally oxygenated or hypoxic state. Groups of adult aquatic newts, Triturus viridescens viridescens, were irradiated, made hypoxic, or irradiated while hypoxic. ^{3}H-labeled cytidine was utilized as a tagged precursor for RNA; autoradiograms of liver cells were made from animals sacrificed up to two days after injection of labeled cytidine. From the autoradiograms, silver grain concentrations over the nucleoli and over the remainder of the nucleus of hepatic cells were recorded for each treatment group at each sacrifice interval. For the early time intervals (three and eight hours) the data from nuclear grain counts demonstrated an oxygen enhancement of radiation inhibition of nuclear RNA synthesis. Although RNA synthesis was markedly reduced by 2000 rads of x ray in normally oxygenated newts, hypoxia alone for either three or five hours produced levels of synthesis lower than did radiation (there was no statistical difference in RNA synthesis in animals kept hypoxic either three or five hours). However, when hypoxic animals were irradiated, the animals kept hypoxic for three hours and irradiated had a lower RNA synthesis than did those kept hypoxic for five hours and irradiated (there was no difference in RNA synthesis between the animals kept hypoxic for five hours and irradiated and those kept hypoxic for either three or five hours and not irradiated). These results do not indicate the classical oxygen effect in which well oxygenated, irradiated animals would have a lower RNA synthesis than hypoxic, irradiated animals; the profound effects of hypoxia in this experiment complicate the results. In the light of the oxygen effect, the results showed a marked inhibition of RNA synthesis when normally oxygenated animals were irradiated; however, since the decrease in RNA synthesis was not different after either five hours of hypoxia or five hours of hypoxia and irradiation, it must be concluded that there was no detectable radiation damage after five hours of hypoxia. (TSS) (Disser. Abstr.)

47490 CHANGES IN THE CONTENT OF FREE CHOLINE IN THE LIVER OF RATS IRRADIATED WITH HIGH-ENERGY PROTONS, GAMMA RAYS, AND FISSION NEUTRONS. Kudryashov, Yu. B.; Arutyunova, O. S. (Moscow State Univ.). Biol. Nauki, No. 2, 58-9(1967). (In Russian).

Equivalent (in lethality) doses of the various kinds of radiation produced similar changes in the choline content of the rat liver. Irradiation with a dose of 300 rem had little effect on the choline level. A dose of 700 rem caused a more prolonged form of radiation lesions than did a dose of 1,500 rem. All the doses produced phasic changes in the choline level. The first phase was elevation of the free choline level characteristic of the early period of radiation lesions. The second phase was marked by a drop in the level two days after administration of a dose of 1,500 rem and three days after a dose of 700 rem (the decrease was steeper than after the 1,500 rem dose). A relationship to the size of the dose was noted only in the phase of accumulation of free choline. For example, in the first phase the choline content after a 700 rem dose increased by 24–34%; after a 1,500 rem dose, by 40–45%. The third phase, that of secondary elevation of the choline level, occurred with a prolonged course of radiation sickness in the second week after irradiation. (JPRS)

47491 INVESTIGATIONS OF CHEMICAL CHANGES OCCURRING IN IRRADIATED ANIMAL FATS. Champagne, Joseph Roger. Amherst, Mass., Univ. of Massachusetts, 1968. 107p. Thesis.

The irradiation of beef and pork fats, under vacuum, revealed the production of a series of n-alkanes (D_1-C_{17}), 1-alkenes (C_2-C_{17}), internally unsaturated alkenes (C_{15}-C_{17}) and alkadienes (C_{13}-C_{17}). The latter two classes of compounds were identified in irradiated triolein, while n-alkanes and 1-alkenes were produced in irradiated tristearin, thereby illustrating one of their probable sources. The definite identification of alkadienes and internally unsaturated alkenes has not been reported previously in irradiated natural fats. In all cases, the unirradiated controls were found free of hydrocarbons. The effect of dose on the volatile production of the irradiated animal fats was studied at 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 mrads. The quantities of all hydrocarbons increased linearly with dose; however, the major products increased with dose at a much faster rate than the minor ones. The effects of temperature and physical rate were determined by quantitative measurements of the volatiles produced from triolein, tristearin and their interesterified mixtures irradiated at −196°, −78°, +75° and +100°C.

The response of product yield to temperature was linear over the entire range. This indicated that the overriding factor in volatile formation was temperature rather than physical state. The unsaturation of the medium was found to profoundly affect the amounts of certain hydrocarbons produced from irradiated mixtures of tristearin and triolein. It is suggested that as the proportion of oleic acid in the mixture increased, hydrogen radicals became less available, probably due to scavenging effect of the unsaturated medium. As a result, large increases in the terminally unsaturated alkenes and alkadienes were observed and increased temperature appeared to accelerate their production. (Disser. Abstr.)

47492 EFFECT OF RADIATION ON IMMUNITY AGAINST HOMOLOGOUS AND HETEROLOGOUS TRANSPLANTATION OF TUMORS. I. EFFECT OF IONIZING RADIATION ON TUMOR IMMUNITY. Tobe, Tatsuo (Gumma Univ., Japan); Okonogi, Takashi. Nippon Igaku Hoshasen Gakkai Zasshi, 28: 150-9(May 1968). (In Japanese).

Wistar strain rats that received subcutaneous transplantation of Yoshida sarcoma were treated with TMTD or Proteus mirabilis, and at the same time they acquired transplantation immunity against the retransplantation of 10^7 Yoshida sarcoma cells. This acquired immunity persisted more than 100 days. When these immunized rats received 500 R whole-body irradiation, the immunity was lost 2 days after the irradiation, and was not restored as late as 25 days. When, however, Yoshida sarcoma cells were retransplanted 9 days or more after the irradiation, the immunity was reacquired by some of them. When mice received heterotransplantation of Yoshida sarcoma, all were cured despite transient proliferation of the tumor cells. But when the transplantation was made 2 days after 500 R whole body irradiation, all the cases died of the tumor. It was consequently assumed that considering the radiosensitivity, the antibody production system may be tissue or cells whose function is abolished about 2 days after the whole body irradiation in a dose of 500 R, and restored after 9 days or more. (NSA of Japan)

47493 ^{51}Cr IN METABOLIZABILITY AND FOOD PASSAGE RATE STUDIES WITH THE RING-NECKED PHEASANT. Duke, Gary E. East Lansing, Mich., Michigan State Univ., 1967. 83p.

Thesis.

Two techniques using chromium-51 were developed. In the first, a single-dose of chromium-labeled food was fed to test birds and the passage rates of the food were determined as the times of the first and last appearance of the label. In the second technique a continuous-dose of uniformly labeled food was fed to test birds for one to several days. The ratio of the concentration of Cr-51 in the food to its concentration in the excreta permitted the ready computation of metabolizability coefficients. The weights of materials ingested and defecated also allowed computation of these coefficients by the total collection method. The two techniques were run in succession and passage rates, metabolizability coefficients, and ingestion rates were determined and compared between cocks, between cocks and hens, between adults and chicks, and for three different diets. However, for an unknown reason, the coefficients as determined by the two methods, did not agree. The metabolizability coefficient of a standard commercial diet averaged 63.49 percent by the total collection method and 53.68 percent by the ratio method for cocks in a controlled environment. The average minimum passage rate of the standard diet for cocks was 0.6 to 1.6 hours while the average maximum passage time for materials not receiving cecal digestion was nine hours and for materials receiving cecal influence the maximum rate was 38 hours. (Disser. Abstr.)

47494 FIXATION OF $^{35}SO_4$ AND ^{45}Ca IN THE METAPHYSIAL TISSUES OF THE HYPOPHYSECTOMIZED RAT TREATED BY SOMATOTROPIC HORMONE OR NOT TREATED. Dupuis, Y.; Graf, B.; Bescol-Liversac, J. (Centre National de la Recherche Scientifique, Paris). Compt. Rend. Ass. Anat., No. 138, 442-54 (Dec. 1967). (In French).

A study was made of the fixation of ^{45}Ca in rats that had undergone hypophysectomy and were treated with somatotropin. It was undertaken in order to develop a method for stopping and starting growth processes by a controlled physiological method. The degree of fixation of $^{35}SO_4$ and ^{45}Ca by osteogenic tissues was compared from a histophysiological standpoint. Wistar rats 4 weeks old and weighing 60 g were used. Fixation of ^{45}Ca and $^{35}SO_4$ was diminished after hypophysectomy, but showed above normal values after treatment with somatotropin. The fluctuations for ^{45}Ca uptake by tissue volumes were not as great as for $^{35}SO_4$. Autoradiography showed that these variations occurred simultaneously in epiphyseal cartilage plates and in neoforming bone. Under the influence of calcium assimilation the process of repair was similar to that observed in rickets and represented active growth. (BBB)

47495 EFFECTS OF WHOLE BODY GAMMA IRRADIATION ON THE TRANSPORT OF IODINE ACROSS THE PLACENTA. Fougeron, Myron George. College Station, Tex., Texas A and M Univ., 1967. 76p.

Thesis.

The effects of whole body gamma irradiation on the transport of thyroxine and iodide across the placenta of the albino rat of the Wistar strain were studied. Pregnant females were irradiated on the 17th day of gestation with doses of 0, 500, 750, and 1000 rads from a ^{60}Co source, delivered at the rate of 600 rads per minute. On the 20th day of gestation the animals were injected with ^{131}I labeled thyroxine or ^{131}I labeled sodium iodine. Twelve hours later the animals were killed by ether anesthesia. The fetuses were homogenated in a Waring blender. Fetuses were homogenated intact within the extraembryonic membranes which included the placenta and amniotic fluids, while additional fetuses were detached from the placenta and membranes and were homogenated separately. The remaining fetuses were fixed in a ten percent formalin solution and later weighed, crown-rump measurements were made, and representative fetuses were photographed. The uterus was homogenated following removal of all the fetuses. The amount of radioactivity present in an aliquot of each of the homogenates was determined by use of a scintillation detector. It was found that the transport of ionic iodide across the placenta was retarded following doses of 500 and 750 rads. The 1000 rad group showed higher readings than the 500 and 750 rad groups, but lower than those of the controls, which indicates a possible increase in the transport of iodine across the placenta. The rate of transfer of thyroxine across the placenta showed no significant difference between the dose levels used in this study. The weight of the fetuses whose dams had been irradiated was less than that of the controls, with no difference observed between radiation levels. Histological examination of the placentae showed no visible damage to the animals which had received 500 rads. Changes were observed in animals that had received 750 and 1000 rads. The basal plate contained many more degenerating cells accompanied by much more debris in this area. There was also a greater amount of hyalinization which accompanies the death of these cells. (Disser. Abstr.)

Ecology

Refer also to abstract 47544.

47496 (PRNC-103) THE RAIN FOREST PROJECT ANNUAL REPORT FY-1967. Kline, Jerry R.; Jordan, Carl F.; Drewry, George E. (Puerto Rico Nuclear Center, Rio Piedras). Contract AT(40-1)-1833. 201p. Dep. CFSTI.

Work done on the Rain Forest Project at El Verde, Puerto Rico is described. The primary experimental plan of forest irradiation including one year of follow-up studies was completed and will be reported by H. T. Odum in a published volume. Since completion of this phase, as of June 30, 1966, the experimental emphasis was shifted to include detailed studies on radioisotope behavior in the tropical forest, and studies on the recovery and succession in the irradiated area. Reports are given on the behavior of fallout radioisotopes in the forest, on the behavior of applied tracers, and on the behavior of tritium. Others are presented on the recovery of the area and include comparative studies of disturbed areas, leaf area index measurements, diversity measurements and observations on vegetative regeneration by sprouting. Some studies initiated as part of the broad ecological approach of the radiation experiment are being continued because of their general importance to the understanding of life processes. These include studies on phenology, light quality, water budgets, and forest metabolism. (auth)

47497 DIMENSION AND PRODUCTION RELATIONS OF TREES AND SHRUBS IN THE BROOKHAVEN FOREST, NEW YORK. Whittaker, R. H.; Woodwell, G. M. (Brookhaven National Lab., Upton, N. Y.). J. Ecol., 56: 1-25(May 1968).

A long-term study of the Brookhaven forest as an ecosystem that includes experimental irradiation of a segment of the forest with γ radiation from a ^{137}Cs source is presented. The plants were taken from the forest outside the area of radiation effects. Dimension analysis of trees and shrubs was made as a first phase of the research on biomass, production, and nutrient circulation. Distributions of biomass and net production among major plant parts are discussed in terms of regressions and of averages for the sets. Study of allometric relations for individuals of all species combined showed trends in the dimensional relations of plant parts that shift gradually and continuously with plant size from small shrubs to forest trees. Regressions within species may be effectively used to estimate weight, production and surface relations of

shrub communities and forests. For this purpose, and in relation to studies of gaseous exchange, nutrient circulation and dominance-diversity structure, the system of analysis had substantial usefulness for the study of shrubland and forest ecosystems. (BBB)

47498 THE DISTRIBUTION OF ^{226}Ra IN AN AQUATIC ENVIRONMENT. Parsont, Michael Allen. Fort Collins, Colo., Colorado State Univ., 1967. 133p.

Thesis.

Investigations into the distribution of ^{226}Ra in an aquatic environment downstream from a uranium mine revealed the following: Sediment ^{226}Ra concentrations were directly related to sediment particle size. Seasonal variation in sediment ^{226}Ra concentrations was not observed. Radium-226 concentrations in particles of both large and small size decreased exponentially with distance from the source of contamination. Filtered water samples contained considerably lower concentrations of ^{226}Ra than unfiltered samples indicating that the greatest portion of the ^{226}Ra was associated with particulate material in the water. Calcium ion concentration was inversely proportional to the ^{226}Ra concentration in the water. No one component of fish stomach contents from three species examined proved to be statistically related to the ^{226}Ra concentration of the stomach contents. An indicator of general fish health used by fisheries biologists was not related to the ^{226}Ra concentrations in either fish flesh or bone. Bone ^{226}Ra concentrations were shown to decrease with age in large mouth bass; this relationship was not observed in either rainbow trout or yellow perch. The root systems of plants contained considerably higher concentrations of ^{226}Ra than the stems and leaves in areas of high sediment ^{226}Ra, but this relation was apparently reversed in areas of low sediment ^{226}Ra concentration. Aquatic insects were shown to concentrate large amounts of ^{226}Ra. (Disser. Abstr.)

47499 IONIZING RADIATIONS IN FORESTS AND FORESTRY (EXCLUDING THE USE OF RADIOACTIVE TRACERS). Lynn, M. (Commonwealth Forestry Bureau, Oxford). Forest. Abstr., 28: 1-18(Jan. 1967).

Sources of radioactive substances in forests and their circulation through the soil and plants are reviewed, as are the effects of ionizing radiation on soil microorganisms, tree seed, and on young plants and trees. Uses of ionizing radiation in forestry work are also discussed. 176 references. (C.O.)

47500 ^{90}Sr ACCUMULATION FACTOR IN PLANKTON OF DIFFERENT BODIES OF WATER. Kalninya, Z. K.; Polikarpov, G. G. (Inst. of Biology, Sevastopol, USSR. Inst. of Biology of Southern Seas, Sevastopol, USSR). Radiobiologiya, 8: 160-1 (1968). (In Russian).

The plankton of eutrophic, mesotrophic-eutrophic, and dystrophic lakes is characterized for the different months of the summer of 1966; the ^{90}Sr accumulation factors are included. A small calcium content in the water of the dystrophic lake (4 to 6 mg/l) caused this plankton to have a larger capacity for ^{90}Sr accumulation than the plankton of the other types of lake. (JPRS)

Genetics and Cytogenetics

Refer also to abstract 47630.

47501 (NP-17136) ANNUAL REPORT NO. 17 OF THE NATIONAL INSTITUTE OF GENETICS, 1966. (National Inst. of Genetics, Mishima (Japan)). 1967. 153p. Dep.

Brief accounts of the various research activities during 1966 at the National Institute of Genetics in Japan are presented. Research reports are included for cytogenetics (8), physiological and developmental genetics (16), biochemical genetics (11), evolutionary genetics (9), mathematical and statistical studies on population genetics (12), radiation genetics and chemical mutagenesis in animals (11), radiation genetics in plants (8), microbial genetics (8), and human genetics (8). A list of the books and papers published during 1966 is also included. (B.S.L.)

47502 (ORNL-TM-2189) BIOLOGY DIVISION NEUROSPORA EXPERIMENT P-1037. Quarterly Progress Report to the National Aeronautics and Space Administration, December 16, 1966-March 15, 1967. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 43p. Dep. CFSTI.

Activities associated with the flight of Biosatellite A and the post-flight assays to determine the genetic effects of ^{85}Sr γ radiation in the ground control portion of the experiment are described. The flight material was not recovered; therefore only data on the ground control portion of the experiment is presented. Some of the data recording and electronic data processing techniques used for the Neurospora experiment are described and/or illustrated. (B.S.L.)

47503 BIOSATELLITE II EXPERIMENTS: PRELIMINARY RESULTS. Thimann, Kenneth V. (Univ. of California, Santa Cruz). Proc. Nat. Acad. Sci. U. S., 60: 347-61(June 15, 1968).

A summary of preliminary results of biosatellite experiments is presented. The space vehicle and preparations for biological experiments are described. Wheat seedlings (Triticum aestivum) were studied for effects of weightlessness on spatial orientation, morphogenesis, histochemistry, and biochemical changes. No differences were observed between these plants and ground controls rotated slowly on a horizontal clinostat. Effects of orbiting on frog eggs (Rana pipiens) were studied; no effects were found on cleavage divisions, morphology, or differentiation of tadpoles. Cellular structure, feeding, and growth studies were conducted on the amoeba, Pelomyxa carolinensis; no abnormalities were noted. Interaction between radiation and flight conditions was studied using Tradescantia, Habrobracon, Tribolium, Drosophila, Salmonella, Escherichia, and Neurospora. Experiments with Tradescantia showed an apparent synergism between flight conditions and irradiation on the cell-division process; disturbed spindle function and other cytological aberrations were noted more frequently after flight than in controls. Irradiated Habrobracon oocytes showed about twice as much lethality as ground controls. The pupal period of orbited Tribolium was 1.5 hours longer than for ground controls, but this was ascribed to lower temperature in flight. Wing abnormalities of beetles irradiated in orbit were much more frequent than those of ground controls. Three times as many wing mutants occurred in orbited Drosophila as in controls. The number of phage particles per cell of Salmonella was somewhat decreased by the flight. Genetic effects of radiation on Neurospora during flight were not different from those of ground controls. (H.L.W.)

47504 EFFECT OF VARIOUS FACTORS ON DISSOCIATION OF BACILLUS BREVIS VAR. G.-B. Zharikova, G. G.; Lukin, A. A. (Moscow State Univ.). Microbiology (USSR) (Engl. Transl.), 35: 83-8(Jan.-Feb. 1966).

A comparative study was made of the effect of uv light, ethylenimine, hydrogen peroxide, structural analogues of the purine and pyrimidine bases (hypoxanthine, 8-azaguanine, 5-bromouracil, triaminohydroxypyrimidine), norsulfazol, and 24 amino acids on the dissociation transformations of 4 forms of B. brevis var. G.-B. Ultraviolet irradiation, ethylenimine, hydrogen peroxide, and 8-azoguanine did not increase the dissociation of the different forms of B. brevis, and with the R form they lowered the index of dissociation. 5-Bromouracil, triaminohydroxypyrimidine, hypoxanthine, and norsulfazol did not affect the dissociation of the various forms of B. brevis. Certain DL-amino acids had a particularly marked action on the dissociation transformations, causing either an increase or a decrease in the dissociation index. The possibility of dissociation was not basically dependent on the character of the action of the amino acids on the development of the bacterial population: an increase or decrease in dissociation was observed whether growth was inhibited or stimulated. Consequently, dissociation may take place not only when the conditions are unfavorable to the development of bacteria. (BBB)

47505 EFFECT OF HYDROXYUREA AND OTHER INHIBITORS OF DNA SYNTHESIS OF VICIA CHROMOSOMES PREVIOUSLY EXPOSED TO X RAYS OR TO RADIOMIMETIC CHEMICALS. Kihlman, B. A.; Hartley, Beryl (Univ. of Uppsala). Hereditas, 59: 439-63(1968).

When root tips of Vicia faba were first exposed to x rays and then treated with inhibitors of DNA synthesis (5-fluorodeoxyuridine, 2'-deoxyadenosine, arabinosyl-adenine, and hydroxyurea), the frequencies of chromatid gaps and breaks obtained were much higher than the sum of gaps and breaks produced by x rays and inhibitor alone. With hydroxyurea (HU) as the inhibitor of DNA synthesis, the increased frequency of gaps and breaks was most striking when HU was given during the last 2½ hr before fixation. The increase was at least as great when the roots were irradiated 18 hr before the HU treatment as when they were irradiated ½ hr before HU. An equally drastic increase in the frequencies of gaps and breaks was obtained when roots were first treated with certain radiomimetic chemicals (nitrogen mustard, maleic hydrazide, streptonigrin, and phleomycin) and then exposed to HU during the last 2½ hr before fixation. The increase was found mainly in cells which were exposed to the radiomimetic agents in early or mid interphase. No increase was obtained when HU was given as a posttreatment to treatments with 8-ethoxycaffeine. (BBB)

47506 SOME INTERESTING CHLOROPHYLL MUTATIONS IN ARABIDOPSIS THALIANA (L.) HEYNH. Kasyanenko, A. G.; Timofeev-Resovskii, N. V. Byull. Mosk. Obshch. Ispyt. Prir. Otd. Biol., 72: 100-5(May-June 1967). (In Russian).

Mutation of the chlorophyll components of Arabidopsis thaliana (Enkheim strain) was investigated after treatment with ^{60}Co γ rays at doses of 10 to 80 kR which was considered to be the most effec-

tive dose range. Hybridization of the plant resulted in development of 132 varieties of monohybrid recessives, of which 6 appeared to be suitable for the experimental program on account of their relative viability and intensity of photosynthesis. Chloroplast mutations induced by radiation resulted in leaves with six distinct shades of green: dark green, light green, yellowish green, greenish white, bright green at the beginning of growth, and a nonpermanent color changing from albinism to green. Chlorophyll mutations of leaves were accompanied by three types of cells with various forms of abnormal chloroplasts. The average photosynthesis intensity was 149 mg CO_2/g of dry matter per hr and the average assimilant quotient was 0.22. The development rate of the mutants was normal and their viability vigorous. (BBB)

47507 RESULTS FROM A ^{60}Co γ-IRRADIATION EXPERIMENT WITH PERENNIAL RYE GRASS PASTURE TYPE R.v.P. AFTER VEGETATIVE PROPAGATION. DeLoose, R. (Centrum voor Landbouwkundig Onderzoek, Rijksstation voor Sierplantenveredeling, Melle, Ghent). Meded. Landbouwhogesch. Opzoekingssta. Staat Gent, 30: 459-67(1965). (In Flemish).

Induction of somatic mutations in pasture type perennial ryegrass R.v.P. (a cross-fertilized) type by γ irradiation was investigated. Two plants, including their roots, were irradiated with 3000 RAD (at 600 RAD/hr) from ^{60}Co. After treatment, each plant together with a nontreated control was propagated by as many vegetative parts as possible that finally formed a clone. Within each clone (control and irradiated) the following characters were followed during two consecutive seasons: date of earing and crude protein contents of individuals at the same physiological stage (frequencies of distribution). Within one irradiated clone (a very late one), a shift towards earlier dates of earing was observed. (One individual showed a difference in earliness of five weeks.) However, the prospect of obtaining higher crude protein contents within the two irradiated clones was not very promising. (BBB)

47508 EFFECT ON A FLOUR BEETLE OF IRRADIATION DURING SPACE FLIGHT. Slater, John V.; Buckhold, Brenda; Tobias, C. A. (Univ. of California, Berkeley). BioScience, 18: 595-7(June 1968).

In the Biosatellite II experiment, 720 Tribolium confusum between 19 and 27 hr old were orbited, half in the presence of ^{85}Sr and half shielded from it. Two-thirds of the pupae in each group had received a preirradiation dose of 1350 R of 180-keV x rays to bring them into the dose range in which the additional in-flight dose would contribute a major portion of the wind damage, i.e. out of the shoulder portion of the dose-response relation. Percentage of wing abnormalities was significantly increased (2.5% level) in the flight group receiving both the x-ray dose and the chronic ^{85}Sr γ-ray dose, compared with the analogous earth control. The flight group developed 44.8% wing abnormalities, compared with 29.9% for the earth group, a 50% increase. Dominant lethality for offspring of females (oocytes) also was significantly increased in this same doubly irradiated flight group. The flight females had 78 ± 6% dominant lethals, compared with 27 ± 5% for ground females, a difference significant at the 2.5% level. Wing damage was a local somatic one occurring during the rapid developmental stage, probably involving chromosomal damage. This result and the enhancement of oocyte dominant lethality indicated that a space-flight factor, probably weightlessness, either facilitated the development of chromosome breaks and/or DNA damage or hindered the normal correction of such errors. (BBB)

47509 EFFECTS OF THE SPACE ENVIRONMENT ON RADIATION-INDUCED DAMAGE IN THE REPRODUCTIVE CELLS OF PUPAE AND ADULT DROSOPHILA. Browning, Luolin S. (Univ. of St. Thomas, Houston, Tex.). BioScience, 18: 570-6 (June 1968).

To determine whether or not radiation effects under weightlessness differed from those on earth, Drosophila in Biosatellite II were exposed to 1495 R of γ rays from a radioactive source (^{85}Sr) while in orbit. Concurrent earth-control experiments were performed at Cape Kennedy, the irradiated group of flies receiving 1466 R of γ rays. A sex-linked recessive lethal mutation rate in mature sperm of 5.07 ± 0.71% was detected among the daughters of the irradiated flight specimens compared to 3.27 ± 0.59% among the irradiated earth controls. The difference was of borderline significance. A recessive lethal rate of 0.39 ± 0.23% was detected among the offspring of unirradiated flight specimens and of 0.21 ± 0.20% among the earth controls, showing no significant differences based upon small samples. A highly significant increase in the frequency of dumpy-wing mutants in mature sperm was found between the irradiated and orbited group (14/20,582) compared to the irradiated earth group (4/24,838). No differences in the rate of losses of the y^+ and B markers from a specially marked Y chromosome were found in the irradiated and unirradiated flight material and the earth controls. In the unirradiated flight material a significant increase in nondisjunction of the X chromosome was found among the daughters of the inseminated females as compared to the unirradiated ground controls (0.087% vs 0.024%). The males hatching from the pupae and the males x irradiated (4000 R) before flight were mated in successive 2- and 3-day intervals. The frequency of loss of markers from the Y chromosome among sons of the males in the pupal stage in the irradiated compartment during the time of flight was 3.57% as compared to 2.22% in the irradiated controls, the difference of 1.35% being significant. Experiments using sperm that were mature at the time of flight showed that flight conditions (weightlessness, acceleration, vibration, etc.) increased their mutational sensitivity to radiation. (BBB)

47510 THE COMBINED EFFECT OF WEIGHTLESSNESS AND RADIATION ON INACTIVATION AND MUTATION-INDUCTION IN NEUROSPORA CRASSA DURING THE BIOSATELLITE II MISSION. de Serres, F. J.; Webber, B. B. (Oak Ridge National Lab., Tenn.). BioScience, 18: 590-5(June 1968).

The inactivation of cells and the induction of chromosome aberrations were studied in identical experiments in orbit and on earth with γ-radiation doses of 884, 2058, and 3116 R. Dose-response curves for survival of heterokaryotic conidia gave regression lines for log of survival ratio on radiation exposure, the slopes of which were not significantly different for flight and earth samples. Dose-response curves for induction of recessive lethal mutations at specific loci (ad-3) were identical for both the flight and earth-control samples. The incidence of recessive lethal mutations over the entire genome was determined on single colony isolates of heterokaryotic conidia. Conidial samples were analyzed from in-flight and earth-control packages that received comparable radiation exposures. This analysis showed no difference between the frequency of recessive lethal mutations obtained with the in-flight and earth-control samples. It agreed with the data from the specific locus studies. (BBB)

47511 GENETIC AND CYTOLOGIC STUDIES OF TRADESCANTIA IRRADIATED DURING ORBITAL FLIGHT. Sparrow, A. H.; Shairer, L. A.; Marimuthu, K. M. (Brookhaven National Lab., Upton, N. Y.). BioScience, 18: 582-90(June 1968).

During the two-day Biosatellite II flight, plants with roots immersed in nutrient were arranged in plastic modules so that the flower buds were exposed to 218 R and the roots from about 125 to 285 R of γ radiation from a ^{85}Sr source. Flight-control plants were located behind a tungsten shield and identical earth-control packages (with and without irradiation) were maintained at Cape Kennedy. Somatic mutation rates, in general, did not change because of spacecraft orbital stresses, but in one case (stamen hair pink mutations) there was a significant antagonistic effect on irradiated flight material for part of the scoring period. There was no general effect on mutation rates that could be attributed to spacecraft factors and this one discrepancy could not be explained. Incomplete analysis of the frequencies of various chromosomal aberrations did not suggest significant differences between flight and earth samples. Irradiated flight samples had higher rates of pollen abortion and stamen-hair stunting that suggested an enhanced effect between weightlessness and irradiation. Bud blasting, microspore death, disturbed spindle function, and other cytologic aberrations were more frequent in both flight samples than in both earth samples; weightlessness and/or other spacecraft environmental factors were considered to be the possible cause of these effects. (BBB)

47512 INTERVAL OF TIME BETWEEN IRRADIATION AND MITOSIS IN A CULTURE OF HUMAN LEUKOCTYES AND THE NUMBER OF CHROMOSOME ABERRATIONS. Kozlov, V. M. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 79-81(1968). (In Russian).

Irradiation of human leukocytes in the presynthetic state in vitro with Co-60 γ rays at a dose of 100 R caused chromosome aberrations in 20% of the cells, most of them paired fragments and dicentrics with a single pair of fragments. Increase of the interval between irradiation and mitosis by days in human leukocytes in vitro did not change the cytogenetic effect of irradiation. (JPRS)

47513 REPAIR OF UV-INDUCED ALLELIC RECOMBINATION IN YEAST. Mori, Shigeyuki; Nakai, Sayaka (National Inst. of Radiological Sciences, Tokyo). Annu. Rep. Radiat. Center Osaka Prefect., 8: 157-8(1967).

The nature and repair of radioinduced damage leading to recombination were studied using diploid yeasts that were uv-sensitive and lacked dark repair ability (A) and non uv-sensitive and possessing dark repair ability (B). It was demonstrated that the yield of uv-induced hetero-allelic reversion in strain A was strikingly increased in comparison with that of strain B at a low dose range. This increased frequency of reversion in strain A was remarkably reduced under conditions of photoreactivation. The dose response

curves of photoreactivation reversion of strains A and B were almost identical. It was concluded that most, but not all, of the uv-induced damage leading to recombination was dark and photoreparable. (B.S.L.)

47514 GENETIC STUDIES OF DROSOPHILA POPULATION. 1. ON THE FREQUENCIES OF SEX-LINKED RECESSIVE LETHAL MUTATION IN D. MELANOGASTER IRRADIATED WITH X-RAYS. Kang, Yung Sun; Kim, Yung Jin; Lee, Chung Choo; Choi, Chung Chie. Zoologica, No. 3, 3-6(Dec. 1964). (In Korean).

The frequency of sex-linked recessive lethal mutations in Drosophila melanogaster Seoul strain males x-irradiated at 500 and 1500 R was observed. The frequencies were determined at three periods with two day intervals and during spermatogenesis after irradiation. The mean frequency of sex-linked lethal mutation appeared as 7.409% during the first 10 days after irradiation at 1500 R. At the three periods tested, no significant difference in the frequencies was observed. In the group irradiated with 500 R, the frequencies of lethal mutation during spermatogenesis were 1.424% in the mature spermatozoa and 4.085% in the spermatocyte. In the other group irradiated at 1500 R, the frequencies of the mutation were 6.464% in the sperm and 12.073% in the spermatocyte. The frequencies of mutation, 0.092 to 0.198%, in the control group showed no significant differences. (auth)

47515 INFLUENCE OF γ RAYS ON THE FORMATION OF ANEUPLOIDY IN MITOSIS. Antoshchina, M. M. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 89-91(1968). (In Russian).

Plasma obtained from the blood of a woman 25 to 35 years old was irradiated with ^{60}Co γ rays at a dose of 100 R and cultivated; the cells were fixed after 60, 72, 85, 95, 110 and 120 hr. After irradiation the frequency of hypoploid cells increased in the second mitosis (fixation after 85 to 95 hr) and was reduced to the spontaneous level in the third mitosis (110 to 120 hr). The frequency of hyperploid cells was far smaller and its variation in time was statistically unreliable. (JPRS)

47516 ON THE PROTEOLYTIC SYSTEMS OF UV MUTANTS OF ASPERGILLUS NIGER. Matsushima, Kin-ichi; Shimada, Kyo (Mie Univ., Japan). Nippon Nogeikagaku Kaishi, 41: 671-4(Dec. 1967). (In Japanese).

Fifty-seven mutants of Aspergillus niger were obtained by uv radiation. Protease activities of these mutants were determined by a modification of Anson's method. The productivity of acid protease was decreased in the mutants. Most of the mutants were similar to the parent in that their proteolytic systems were composed principally of acid protease. However, there were two mutants in which the proteolytic systems consisted predominantly of alkaline protease. Both of these mutants were of the Albino type. (NSA of Japan)

47517 NON-RECIPROCAL RECOMBINATION TO EXPLAIN OBSERVED ABERRANT SEGREGATION. Ranneberg, H.; Arnold, C. G. (Univ., Erlangen, Ger.). Mol. Gen. Genet., 102: 27-38 (1968). (In German).

In crosses of a p-aminobencoic acid requiring mutant of Chlamydomonas reinhardi with the wildtype, besides the expected 4:4 segregation, a surprisingly high frequency of aberrant segregation was observed, all of which preferentially led to the wildtype. The only possible explanation of this finding was a non-reciprocal recombination, as mutations, trisomy, and the loss of a tetrad cell with following additional division of a sister cell can be excluded. The molecular mechanism of non-reciprocal recombinations is still unknown. Nevertheless these findings are best understood if the hybrid-DNA model of Holliday is accepted, especially because this model is not only able to explain the 5:3 and 6:2 tetrads, but also the 7:1 and 8:0 segregations that occur at a much lower rate. The frequency of non-reciprocal recombinations could be reduced by irradiating zygotes at the very beginning of the germination period. If the X-rays were applicated 6½ hours after induction of the germination, no clear aberrant segregation could be found. The reduction of the frequency of non-reciprocal recombinations by X-rays led to the conclusion, that the mechanism of mutation and conversion are not identical. On the other hand, many mutagenic substances that also cause non-reciprocal recombination are known. Thus it can be supposed that both the

47518 CHEMICAL CONSTITUTION AND MUTAGENIC ACTIVITY. IV. CYCLICAL N-LOST-DERIVATIVES. Roehrborn, Gunter (Univ., Heidelberg). Mol. Gen. Genet., 102: 50-68(1968). (In German).

A number of bifunctional chloroethylamines with different basic structure were tested for their mutagenic effectiveness in Drosophila. The test substances were applied orally to 1 to 3 day old males of the stock Berlin wild of Drosophila melanogaster and the ratios of recessive X-chromosomal lethal mutations were ascertained by means of the Basc-method. In experiments to modify the mutagenic effects of phenyl-lost-derivatives by substitution in para-position to the lost nitrogen we obtained the following sequence of mutagenicity (R = substituent): R = NH_2 > H > OCH_3 ~ CHO > Cl = control. The differences in mutagenicity were partly restricted to specific stages of the cycle of spermatogenesis. There was no correlation between mutagenicity and chemical reactivity. The mutagenicity increased proportionally to duration of feeding. The mutagenic activity of the cytostatically ineffective and only extremely weakly reactive p-Bis-(β-chloroethyl)-aminobenaldehyde (C.B. 1077) shows that chemical reactivity tests are not suited for the estimation of the mutagenicity of drugs by routine. In the series of the bifunctional N-lost-cyclophosphamides the mutagenicity decreased in the series B 801 > B 518 ≧ B 525 according to the chemical reactivity. The differences between the mutagenic activity of B 801 and the other substances were especially significant in mature spermatozoa. The sensitivity of the stages of the cycle of spermatogenesis was tested by fractionated matings against the mutagenic impulse of the test substances. Generally the observed mutations were due to changes, induced in postmeiotic and meiotic germ cell stages. Mature spermatozoa proved especially sensitive against p-Bis-(β-chloroethyl)-aminophenylalanine (C.B. 1128), while on the other hand the efficiency of Cytoxan on this stage was relatively weak. The toxicity of the aromatic nitrogen-mustards was neither correlated with the mutagenic activity nor with the chemical reactivity of these compounds. The most active mutagen had the weakest and the weakest mutagen the highest toxicity. Simultaneous application of C.B. 1128 and 1-cysteine led to a drastical decrease of the mutation rate in comparison with the C.B. 1128 control; previous cysteine treatment was ineffective. The feeding of cysteine and cysteamine before X-irradiation with 2,000 R and 3,000 R, respectively, had no inhibiting effect on the X-ray induced mutations.

47519 A YEAST MUTANT, SUPERSENSITIVE TO ULTRAVIOLET RADIATION. Zakharov, I. A.; Kozhina, T. N. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR, 176: 1417-18(Oct. 21, 1967). (In Russian).

Studies on mutants of Escherichia coli with increased radiation sensitivity indicated that the natural sensitivity of the cells is due to the gene-controlled ferment activity that is involved in the regeneration of radiation injury in DNA molecules. Supersensitive strains of Saccharomyces cerevisiae mutants derived from the p-192-158-P4 haploid, αad_2 genotype were used to investigate the problem, exposing the cells to uv radiation. The mutant exhibited a LD of 35.28 and the original strain 750.82 erg/mm^2. It had a pale reddish coloration, as compared to the strong red color of the original strain, and was unable to grow in a medium containing alcohol instead of glucose, indicating a respiratory insufficiency. In order to clarify the genetic character of the mutant, it was crossed with the haploid 6-PGZ, αad_1 genotype, studying the segmentation in the resulting PG-59 hybrid. It was found that segmentation into two genes takes place; this determines the coloration and the sensitivity toward uv radiation. This indicated that two simultaneous mutations occurred. It was concluded that the natural radiation sensitivity of this yeast is controlled by the genes. (TTT)

47520 CYTOGENETIC EFFECTS OF RADIATION IN MAN. Bochkov, N. P. (Inst. of Medical Radiology, Moscow). Med. Radiol., No. 12, 45-52(Dec. 1966). (In Russian).

Interest in the genetic effects of radiation, i.e., various alterations of chromosomes and increase in their number, has been intensified by the realization that chromosome mutations in human populations are not as rare as hitherto believed and by the experimental evidence that chromosomes are highly radiosensitive both in vitro and in vivo and that chromosome aberrations persist for a long time. The article presents a detailed review of the literature, mostly of the past 5 years, under three headings: 1 chromosome diseases and radiation, 2 chromosome aberrations in the somatic cells resulting from diagnostic procedures, radiotherapy, occupational exposure, and reactor accidents, and 3 experimental data on the effect of radiation on human chromosomes. It is concluded with the recommendation that clinical physicians use cytogenetic data. Calculation of the number of chromosome aberrations can be used as a method of biological dosimetry, while the dynamics of chromosome aberrations can serve as a means of judging the effectiveness of treatment, prognosis, and sequelae. (JPRS)

47521 FREQUENCY OF ABERRANT CELLS AND THE AMOUNT OF BLOCKING OF THE CELL CYCLE AS A FUNCTION OF UV-IRRADIATION. Antoshechkin, A. G. (Inst. of Atomic Energy, Moscow). Radiobiologiya, 8: 151-2(1968). (In Russian).

Fibroblast-like aneuploid cells of the Chinese hamster were treated with ^{3}H-thymidine, UV-irradiated with λ ≈ 260 mμ at doses of 15, 30 and 60 ergs/mm^2, and fixed after definite times of incubation. The time after which 45% tagged metaphases occurred was recorded: 15 hr for unirradiated cells and 18 and 21

and 28 hr for those receiving 15, 30 and 60 ergs/mm^2, respectively. A dose of 120 ergs/mm^2 led to massive death of the cells. Thus there was a linear dependence of the amount of blocking of DNA replication on the dose. To study the appearance of cells with chromosome aberrations, the cells were irradiated at doses of 15, 30, 45 and 60 ergs/mm^2 in the S stage, the period of high sensitivity to UV-irradiation, and fixed 10, 12, 14 and 16 hr after those doses, respectively. Comparison of the occurrence of cells with chromosome aberrations with the retardation of the cell cycle showed that even 15 ergs/mm^2, which only slightly affected the level of aberrant cells, retarded the cell cycle by about 3 hr. Therefore UV irradiation could not induce chromosome aberrations without blocking the cycle of DNA replication. (JPRS)

47522 DIPLOIDIZATION OF INDUCED TETRAPLOID HYBRIDS OF DACTYLIS GLOMERATA BY MEANS OF X-RAY IRRADIATION. Devine, Thomas Edward. Ames, Iowa, Iowa State Univ., 1967. 73p.

Thesis.

Two of the 16 clones used as pollen parents and irradiated premeiotically with 650 R and 750 R produced seed in intrasubspecific crosses. These were subspecies Aschersoniana (650 R), and subspecies lusitanica (750 R). The progeny from these crosses did not differ appreciably from the control crosses in pollen fertility or meiotic pairing behavior. Plants with low pollen fertility were selected in the irradiated population as parents for the second cycle of irradiation and concomitant intersubspecific hybridization. Seven hundred and fifty roentgens were applied postmeiotically to three sib clones of Aschersoniana used as pollen parents in crosses to three sib clones of lusitanica. Seed set in these crosses was satisfactory. Progeny from the irradiated crosses had significantly reduced pollen fertility and chiasma frequency compared to the control. Tetraploid sectors were produced in the hybrids by two methods of colchicine application: immersion in an aqueous solution of 0.1%, 0.2%, or 0.4% colchicine, and application of a capillary tube containing an aqueous solution of 0.2%, 0.4%, or 0.8% colchicine. Pretreatment with a nutrient solution at one hour and twenty-four hours prior to immersion in the colchicine solution failed to appreciably increase the success of doubling. The highest frequency of doubling occurred in the treatment by immersion in a 0.4% aqueous solution of colchicine. Quadrivalent frequency was used as the primary measure of autosyndesis. While quadrivalent frequency at first metaphase appeared reduced in the irradiated population compared with the control, the difference was not statistically significant. Chiasma and bridge frequencies were lower in the irradiated population suggesting reduced homology of the irradiated chromosomes. The correlation coefficients of chiasma and quadrivalent frequency within plants appeared greater in the irradiated population. This was associated with a lower chiasma frequency in the irradiated population (significant at the 10% level). (Disser. Abstr.) (TSS)

47523 EFFECTS OF REPEATED IRRADIATION ON CHROMOSOME ABERRATIONS AND POLLEN ABORTIVENESS IN WHEAT. Shchapova, A. I.; Budashkina, E. B. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Tr. Mosk. Obshchest. Ispyt. Prir., Otd. Biol., 23: 97-100(1966). (In Russian).

Dry seeds of wheat species Triticum aestivum and T. timopheevi viticulosum were γ irradiated with 2 and 5 kR to increase the yield of mutants resistant to rust and to study irradiation effects as seen by chromosome aberrations and pollen abortiveness. Both species irradiated with the 5-kR dose showed in the 2nd generation (M_2) a considerable number of chromosome aberrations in rootlets. Repeated γ irradiation (2-kR dose) in M_2 induced in the second species a much higher percentage of cells with aberrations than after the 1st treatment. Also, both species of wheat showed in M_2 a substantial amount of fragments which greatly exceeded the number of bridges. Percentagewise, the amount of aborted pollen in M_2 was twice as high as in M_1 (1st generation) and it was higher particularly after repeated (2-kR dose) irradiation in M_2. (BBB)

47524 THE INFLUENCE OF EXOGENOUS DNA OF DIFFERENT ORIGIN ON THE MITOSIS AND CHROMOSOMES OF IRRADIATED MERISTEMATIC CELLS OF VICIA FABA. Slotova, Jana; Karpfel, Z. (Inst. of Biophysics, Brno). Biol. Plant. Acad. Sci. Bohemoslov., 10: 190-8(1968).

The possibility of repair by DNA of radioinjury in bean tissue was studied using heterologous (mouse spleen) and isologous DNA in the repair of primary root meristematic cells of V. faba. Roots x-irradiated with 150 R were cultured at different time intervals either in tap water or in a solution of the DNA. Mitotic activity of meristematic cells showed that both types of DNA studied enhance the recovery of irradiated cells. The frequency of postmetaphase chromosomal aberrations of irradiated cells was influenced also by postirradiation action of exogenous DNA. While heterologous DNA exhibited a synergic effect with radiation, in the sense that it increased the postirradiation incidence of aberrations in all time intervals studied, isologous DNA had a strong repair effect. Its application caused a significant decrease of the percentage of postmetaphase aberrations. Both kinds of DNA caused changes in the relation of chromosome to chromatid aberrations; a higher percentage of chromatid aberrations was seen. Study of the distribution of aberrations between large and small chromosomes of V. faba showed that the postirradiation use of heterologous DNA increased damage to small chromosomes while isologous DNA caused an increased repair ability in such chromosomes. (BBB)

47525 COMPARISON OF GENETIC VARIANCES AND ESTIMATED RESPONSE TO SELECTION BETWEEN THE IRRADIATED AND NON-IRRADIATED GROUPS IN TWO INBRED LINES OF MAIZE. Mumm, Robert Franklin. Lincoln, Nebr., Univ. of Nebraska, 1967. 84p.

Thesis.

Random sub-lines were developed from a thermal neutron irradiated and non-irradiated source of the two maize inbred lines N6 and N25. Sixty-eight sub-lines were available for test from both sources of N6 and 42 sub-lines were available from both sources of N25. These sub-lines were evaluated by two methods in order to compare the relative magnitude of the genetic variances and the potential for line improvement in the irradiated and nonirradiated groups. The first method involved crossing each sub-line from both groups to two testers, the inbred line Hy and a related-line single cross (N15 × N15A), and comparing the means and variances of one group with those of the other group. The second method was a Design II experiment (Comstock and Robinson, 1952) to obtain more refined estimates of genetic variance in the two groups and to make comparisons between the groups. Data were taken on yield, moisture at harvest, stalk lodging and dropped ears in the testcross experiments and on yield, plant and ear height, days to flowering and number of ears in the Design II experiments. The results of these tests indicate that the primary effect of thermal neutron irradiation on genetic variance is through the production of qualitatively inherited traits which cause skewness in the distributions of genetic effects and an upward bias in the estimations of variance components. Heterozygous translocations caused severely skewed distributions to occur for yield in both the N6 and N25 irradiated groups. A brachytic dwarf mutation produced skewed distributions for plant and ear height in the N25 irradiated populations. The genetic variability among those lines in the irradiated group which did not contain qualitative gene mutations or translocations was not significantly different from that of the non-irradiated group. A discussion of the effect of non-normal distributions of genetic effects on the interpretation of genetic variance components and a possible method of comparing the expected results of selection in the irradiated and non-irradiated groups are presented. (Disser. Abstr.) (TSS)

47526 A STUDY OF RADIATION-INDUCED DOMINANT LETHALS AND TRANSLOCATIONS IN DROSOPHILA VIRILIS IN AN OXYGEN ATMOSPHERE AT 4°C. Omundson, Glenn Erwin. Austin, Tex., Univ. of Texas, 1967. 77p.

Thesis.

Males of the Texmelucan strain of Drosophila virilis were collected within three hours of eclosing. At the age of 19 to 22 hours, these males were irradiated with 0R, 500R, 1000R, 1500R, or 2000R of 250kVp x rays at 500 R/min in an oxygen atmosphere at 3.5°C. Following recovery from this treatment, males were mated individually to one wild-type and three genetically marked virgin females. Starting the sixth day after eclosion, these males were remated every other day for seven periods. The wild-type females were placed in fresh egg-count vials for four egg-count periods. Eggs were counted daily, and dominant lethality was determined as the percentage of eggs which failed to pupate. Translocation tests were made by mating the treated males of the 1000R, 1500R, and 2000R series to marker virgins. The resultant heterozygous F_1 males were individually backcrossed to marker virgins. The presence of induced translocations in the F_2 generation was then scored. Y-chromosomal participation was recorded by noting the distribution with respect to sex. The sixth (dot) autosome and X chromosome were not followed. The data indicated that the combined effect of oxygen and cold temperature in the controls was negligible, but at 500R, damage rose rapidly as measured by dominant lethals (measured as combined chromosomal and cytoplasmic damage), peaking at 79% in cells in early spermiogenesis. At 1000R, dominant lethality exceeded 95% in these cells, a value higher than previously reported. Similar, though higher values, were found in the 1500R and 2000R series. The degree of radiation damage as measured by translocations was recorded for 1000R, 1500R, and 2000R of x rays, but due to severe lethality and sterility factors operative at the higher doses, only about one-half of the mating periods could be scored, and these could not be considered

complete due to the small numbers of sperm producing viable offspring. (Disser. Abstr.) (TSS)

Health Physics and Safety

Refer also to abstracts 47262, 47275, 47294, 47305, 47307, 47315, 47325, 47563, 47626, and 48393.

47527 (JAERI-1156) ESTIMATION OF DOSE BY INHALATION AND MONTHLY CONCENTRATION IN AIR OF FALLOUT. Kasai, Atsushi (Japan Atomic Energy Research Inst., Tokai Research Establishment). 1968. 18p. (In Japanese). Dep.

The methods used for estimation of the internal dose from fallout by inhalation and the external dose from fallout on the ground surface are described. The fallout samples were collected with a continuous dust-sampler. Zirconium-niobium-95, cesium-137, strontium-90, iodine-131, and antimony-125 in the fallout were determined by using gamma spectroscopy and chemical analysis. The external dose from the ground surface in 1963 was 22.8 mrem per year. It was of the same order for the dose from natural radiation. The lung dose from inhalation of the ^{95}Zr-^{95}Nb in 1963 was 3.2 mrem per year. (auth)

47528 (NRC-TT-1332) PRODUCTION AND DISCHARGE OF TOXIC AND RADIOACTIVE GASES IN LINAC TUNNEL IN FRASCATI. Ladu, M.; Pellicioni, M.; Roccella, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Translated by D. A. Sinclair for National Research Council of Canada, Ottawa, from report LNF-65/21. 13p. Dep.

The production of the toxic gases nitrogen dioxide and ozone and the nuclides oxygen-15, nitrogen-13, and chlorine-38 in the Frascati 400-MeV linac tunnel is calculated, and the ventilation requirements are calculated to ensure concentrations below the maximum admissible levels for personnel safety. (W.H.K.)

47529 (ORNL-TM-2190) NEUROSPORA EXPERIMENT P-1037. Quarterly Progress Report to the National Aeronautics and Space Administration, March 16-June 30, 1967. (Oak Ridge National Lab., Tenn.). May 1968. Contract W-7405-eng-26. 27p. Dep. CFSTI.

Some of the problems encountered in the use of the passive dosimetry system that was selected for use in the Neurospora modules in the Biosatellite experiments and the development of procedures required to use these dosimeters with accuracy are described. The reasons as to why Con-Rad disk dosimeters composed of lithium fluoride powder embedded in teflon were chosen are given. It was discovered that the variability in sensitivity of the dosimeters was greater than the manufacturer's predictions; there was also considerable variation in the weight. Ways of increasing accuracy are described. (B.S.L.)

47530 SOMATIC AND GENETIC RADIATION EXPOSURES OF PATIENTS DURING SURFACE KYMOGRAPHY OF THE HEART. Schulte-Brinkmann, Wolfgang; von Cysewski, Ekkehard (Univ., Duesseldorf, Ger.). Strahlentherapie, 135: 675-80(June 1968). (In German).

Measurements on a phantom and 74 patients were done in order to determine the skin and the gonadal dose during areal kymography of the heart. The mean surface dose was 1.2 R for sagittal kymography and was 2.3 R for frontal kymography. The mean values of the male gonadal doses (without lead protection) were 4.9 mR (sagittal) and 1.8 mR (frontal). These values could be reduced to 0.8 and 1.1 mR, respectively, when lead protection was used. (auth)

47531 IN VIVO DOSIMETRY BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Brady, John M.; Aarestad, Norman O.; Swartz, Harold M. (Walter Reed Army Medical Center, Washington, D. C.). Health Phys., 15: 43-7(July 1968).

Several tissues, especially hard tissues, showed persistent electron spin resonances following in vivo or in vitro irradiations. The resonances had a linear relation to dose. Dose measurements were made in teeth at less than 100 rads of ^{60}Co radiation. The method appears to be applicable for dosimetry of accidental irradiations, especially x- or gamma-ray exposures. (auth) (UK)

47532 ALPHA-RAY ACTIVITY IN CORONARY ARTERY DISEASE. Elkeles, Arthur (Prince of Wale's General Hospital, London). J. Amer. Geriat. Soc., 16: 576-83(May 1968).

The ash concentrations and α activities of the coronary and of the common carotid arteries were examined in 16 subjects who died of ischemic heart disease and in 17 subjects who died of other causes at comparable ages. The ash concentrations in the coronary arteries of the experimental subjects were twice as high as in those of the controls but were very low in the common carotid arteries of both groups. Postmortem radiography of these vessels revealed more Ca deposits in the coronary arteries of the subjects with fatal ischemic heart disease than in those of the controls. No Ca deposits were visible in the common carotid arteries of both groups. The wet-tissue α activities in the coronary arteries of the experimental subjects were 4 times higher than in the controls, 5 times higher than in their own common carotid arteries, and 10 times higher than in the common carotid arteries of the controls. The mean α activities in the coronary arteries of subjects with fatal ischemic heart disease equaled that in human bones and were higher than in any other soft tissue in the human body. It is known that ionizing irradiation of larger arteries can produce severe atheromatous lesions in animals and in human beings within a relatively short time. The concept is advanced that the low levels of α radiation in the arterial wall, which increase with age, may cause subtle injuries to the arterial structures, thus contributing to the development of atherosclerosis. (BBB)

47533 PATHS OF PROTONS IN BIOLOGICAL TISSUE. Drozd, G. G. (Inst. of Genetics and Cytology, Minsk). Radiobiologiya, 8: 142-5(1968). (In Russian).

Calculations of the path of protons in biological tissue in the energy range of 500 eV to 10 MeV are presented. A formula already available was used for the region 500 eV to 1.0 keV. A formula was derived for the region 10 to 900 keV, and literature data are used for the region 900 keV to 10 MeV. Good fit of the curve segments was obtained. (JPRS)

47534 FACTORS INFLUENCING THE ACCUMULATION OF ^{90}Sr, STABLE STRONTIUM, AND CALCIUM IN MULE DEER. Farris, Gerald Charles. Fort Collins, Colo., Colorado State Univ., 1967. 205p.

Thesis.

Concentrations of ^{90}Sr, stable strontium, and calcium were measured in mule deer bone and in eight forage species that were sampled over a five year period from the Cache la Poudre drainage in north central Colorado. Vegetation was collected from sampling points within each of the major plant communities utilized by deer. A definite temporal trend in ^{90}Sr concentrations in plants and bones of fawn and yearling deer was observed from 1961 to 1965. Plants and deer reached peak ^{90}Sr concentrations in 1963 with decreases in activity in 1964 and 1965. Summer forage plants were generally higher in ^{90}Sr, stable strontium, and calcium levels than in those species available to the deer in the winter. However, more variation was observed between species and locations of summer range plants than in winter range plants. Comparisons were made on ^{90}Sr, stable strontium, and calcium levels observed in forage and deer rumen contents. Yearly mean ratios were similar indicating the isotope content of plants sampled was representative of the actual consumption by deer. Stable strontium levels in deer bone ranged from 0.184 to 0.632 mg Sr/g ash. Lower stable strontium concentrations were observed in fawns than in mature deer. No significant differences in ^{90}Sr, stable strontium and calcium concentrations were observed between the sexes of deer. Observed ratios (Sr/Ca in bone ÷ Sr/Ca in diet) of 0.316, 0.183 and 0.189 were calculated for fawn, yearling and adult deer, respectively. Annual turnover rates of strontium in bone were estimated as 32 percent for yearling and 7 percent for adult deer. A mathematical equation was used to calculate ^{90}Sr concentrations in the bones of deer as a function of their age. Predicted ^{90}Sr concentrations agreed well with the observed data. (Diss. Abstr.)

47535 RADIATION EXPOSURES DURING THE BIOSATELLITE II FLIGHT. Hewitt, John E. (Ames Research Center, Moffett Field, Calif.). BioScience, 18: 565-9(June 1968).

Seven of the biological experiments flown on Biosatellite II were designed to determine the combined effects of radiation and weightlessness on lethality and mutagenesis. Biological materials were exposed to an onboard source of radiation during the flight. The biological specimens that were flown received the same radiation exposure as the corresponding specimens in an earth-control capsule. This was indicated by dosimeter readings and also, inferentially, by the close agreement of the strengths of the sources. The delivered doses were in agreement with an exposure time of 42 hr instead of the nominal 65 hr. The radiation exposures in the control areas were quite low, as determined by LiF dosimeter readings. Few were above 0.5 R. Ion-chamber measurements independently confirmed the low values. Nuclear emulsion measurements were made of the numbers of protons and heavy ions entering the spacecraft during orbital flight. An upper limit for the mission dose due to protons was 40 mRad. There were 10.1 traversals of atomic nuclei of $Z = 20$ through each cm^2 during the flight. The results indicated that, with respect to the radiation environment, the conditions for a successful experiment were met. (BBB)

47536 THE CENTER FOR THE DETECTION OF RADIOACTIVE CONTAMINATION IN FOODS. Nucciotti, L. (Univ.,

Pavia, Italy). Ig. Sanita Pubblica, 20: 417-26(Sept.-Oct. 1965). (In Italian).

The somatic and genetic damages caused in humans by ionizing radiations or by the action of radioisotopes ingested with food and drink are briefly discussed. The organization and the functions of a center at the Institute of Hygiene of the University of Pavia for the detection of radioactive contamination in food are described. Results from food sampling in the provinces of Pavia, Novara, and Bergamo are also discussed. (auth)

47537 THE UNITS "BER" AND "EQUIVALENT RAD." Isaev, B. M.; Bregadze, Yu. I.; Korshikov, A. V. Izmer. Tekh., No. 11, 20-2(1966). (In Russian).

Objections to GOST 8848-63, establishing standard units for radiological measurements, raised by Yudin and Keirim-Markus are answered. Since GOST 8848-63 permits use of the units rad and roentgen in addition to or instead of the official standard units joule/kg and coulomb/kg, there is no need to revise the GOST standard as suggested by Keirim-Markus. Elevation of ber and rem to the status of standard units is felt to be premature, in the absence of a standard scale or procedure for reproducing these units or calibrating instruments with them. Yudin's suggestions that the ICRU (International Commission on Radiological Units) term dose equivalent be replaced by a new term, equivalent dose, is rejected as making a distinction where no difference exists, and as defeating the ICRU's efforts to reserve the noun dose to denote absorbed dose. There is likewise no need to invent a special new unit, the equivalent rad, to express dose equivalent (Yudin's equivalent dose), since the units ber and rem already exist for this purpose. (ATD)

47538 PROBLEMY KOSMICHESKOI BIOLOGII. TOM VII. RABOCHAYA DEYATEL'NOST', VOPROSY OBITAEMOSTI I BIOTEKHNOLOGIYA. (Problems in Cosmic Biology. Volume VII. Performance and Reaction of Personnel, Problems of Survival, and Biotechnology). Chernigovskii, V. N. (ed.). Moscow, Izdatel'stvo Nauka, 1967. 552p.

Seventy two articles are collected on the problems concerning the psycophysiological aspects of the activity, survival, hygiene and life necessities of astronauts manning the space ships. Problems of biotechnology are discussed considering the γ-ray and proton effects on Chlorella. (R.V.J.)

47539 RADIATION TO THE FETUS IN INTRAUTERINE TRANSFUSION. Peddle, Leo J.; Campbell, E. M. (Winnipeg General Hospital, Manitoba). Amer. J. Obstet. Gynecol., 100: 366-70(Feb. 1, 1968).

The dose of radiation delivered to 29 fetuses transfused in utero and possible ways of reducing this amount in future cases were studied. Assessment of exposure delivered the fetus was made on the basis of measurements of the exposure at the maternal skin level using a radiographic technique involving, 60 ma-sec, 40-in. focus-film distance, 90 to 95 kVp for anteroposterior techniques, and 100 to 110 kVp for lateral techniques. An ionization chamber-type dosimeter calibrated in roentgens was used. The number of anteroposterior radiograms taken in preparation for intrauterine transfusion ranged from two to eleven with a mean of 3.6/transfusion. The number of lateral radiograms associated with intrauterine transfusion ranged from one to four, the mean being 1.3 per transfusion. The dose of radiation delivered at the depth of the fetus per intrauterine transfusion ranged from 0.44 to 2.18 R, the mean exposure being 0.80 R. In three fetuses that received four intrauterine transfusions each, the accumulated radiation dose per fetus ranged from 2.42 to 3.74 R, with a mean of 3.04 R. Hence, the largest accumulated amount of radiation delivered to the depth of the fetus was 3.74 R and in most cases the exposure was far below this amount. In comparison, the radiation exposure at the depth of the fetus in x-ray pelvimetry was about 3.5 R. (BBB)

47540 SOME THERAPEUTIC APPLICATIONS OF RADIOISOTOPES. Harper, Paul V. (Argonne Cancer Res. Hosp., Ill.). J. Miss. State Med. Ass., 7: 526-33(Oct. 1966).

Advances in the use of radioisotopes for treatment of malignant tumors were reviewed, along with shielding problems and prevention of injury of normal tissues. In some instances it was desirable to use a radioisotope more easily shielded than Ra, and in a form with more flexibility. One such material is Ta wire, which was made radioactive by neutron activation. The β radiation from the Ta was shielded by coating the wire with Pt. Applicators containing ^{192}Ir were described in which these sources were embedded in small plastic tubes or threads which were threaded through the tumor. The ends of the threads and then the active lengths were withdrawn from a shield and into the tumor. The exposure to the operator was greatly reduced since the γ energy, which is around 250 to 300 keV, was easily shielded. It was also shown how an experimental implant in the pancreas of a dog resulted in destruction of tissue in the implant, with preservation of the nearby bowel, which was not damaged appreciably, and minor changes in the nearby pancreas. It was possible to destroy this portion of pancreas with a dose of 30,000 R delivered over a period of three months. Such an implant was also used in a tumor of the pancreas of a patient. It was possible to use such implants much more safely than the ordinary unshieldable γ emitters. The effect of β radiation from radioiodine in polyethylene tubing passed through the liver was illustrated. Around the tract there was complete destruction of the tissue by the very intense β radiation field surrounding the source. (BBB)

47541 RADIOACTIVITY IN LIVING BEINGS, IN FOODS, AND IN THE AIR. Puissegur, Juan Adolfo. Rev. Sanid. Mil. Argent., 64: 49-56(Jan.-Feb. 1965). (In Spanish).

The principal radioelements produced by fission are tabulated, with half-lives, mode of decomposition, radiation energy, and products formed. The mission of the veterinary-inspector of meats was outlined, as was that of the laboratory of radiobiology. Contamination of the biosphere by ^{131}I, ^{90}Sr, ^{137}Cs was detailed. The maximum acceptable concentrations of radioactive contaminants in water after an atomic explosion were tabulated. In air the maximum admissible concentrations were 1000 pCi/m^3 of a mixture of β emitters, and 200 pCi/m^3 of ^{90}Sr. Levels in living beings were quoted from American and Canadian studies of 1957 to 1959. The maximum admissible concentration of ^{90}Sr in food as a function of Ca content was 1000 pCi/g Ca for an individual, and 100 pCi/g Ca for a population. It was necessary to send appropriate personnel to laboratories in the U.S.A., Japan, and France, for further study. These would return to Argentina to form the nucleus of instruction in the army and outside it; personnel would be trained at community, provincial, and national levels. (BBB)

47542 DOSIMETRIC CHARACTERISTICS OF X-IRRADIATION AND MEASUREMENT OF ABSORBED DOSES AFTER IRRADIATION OF SMALL BIOLOGICAL OBJECTS. Nikulin, Yu. P.; Nefedova, A. I.; Palitsyn, B. P.; Ratner, T. G. (Inst. of Biophysics, Moscow. Inst. of Biochemistry, Moscow). Radiobiologiya, 8: 131-4(1968). (In Russian).

The measurement of the quality of radiation generated under specific conditions of radiation and of the absorbed doses obtained in that case by water-equivalent biological objects with a volume of not more than 2 to 3 ml, irradiated near the focus of the tube to obtain as large a dose rate as possible is reported. It was found that to describe the x irradiation with a maximum voltage on the tube of 50 to 200 kW it was necessary to note the following characteristics: the maximum voltage on the tube, the effective radiation energy, the layer of half-attenuation, the coefficient of uniformity and the absorbed dose rate. The effective energy could remain constant with the use of near focus apparatus while the dose rate varied by ±25% because of various factors not readily taken into account. Therefore, dosimetry should be carried out immediately before irradiation. (JPRS)

47543 WHOLE BODY COUNTING AND CLEARANCE RATE STUDY FOLLOWING AN ACCIDENTAL EUROPIUM OXIDE INHALATION EXPOSURE OF TWO ADULT MALE SUBJECTS. George, Robert Eugene. Lafayette, Ind., Purdue Univ., 1966. 102p. Thesis.

Over a six month period the body burdens of inhaled radioactive europium isotopes were measured 32 and 29 times, respectively, in two adult male subjects, Z. G. and H. N., who had been accidentally exposed to airborne radioactive europium oxide in the Physics Department at Purdue University. Purdue's large volume liquid scintillation counter, SINCO-P, was used for the measurements. Calibration standards were prepared from europium recovered at the scene of the incident. Activity of the recovered material was determined using a 4-pi, gas-flow, G-M counter, and values obtained were corroborated by internal liquid scintillation counting and gas-flow proportional counting. Excreta specimens collected continuously during the first week following the exposure and at less frequent intervals thereafter, were counted for europium activity using liquid scintillation and NaI(Tl) scintillation detectors. Gamma ray spectroscopy indicated the presence of Eu-156, Eu-155, Eu-154, and Eu-152 in the europium oxide. Repeated counting of standards and excreta specimens showed that 93.5% of the activity at the time of the exposure was due to Eu-156. The abundances of Eu-155, Eu-154, and Eu-152 in the europium oxide were established from gamma spectra collected with a 4 inch NaI(Tl) crystal and a 400 channel analyzer. The activities of these long-lived europium isotopes were determined to represent, respectively, 3.25%, 2.9%, and 0.35% of the total activity at the time of the incident. After excreta measurements and whole body counts were combined and decay corrections applied, the internal body burdens of europium isotopes immediately following exposure were calculated to be 55 μCi and 38.5 μCi for subjects Z. G. and H. N., respectively. The lung model of the 1959 Report of Com-

mittee II of the ICRP was used to calculate lung doses to infinity. Results were 4.4 rad for Z.G. and 3.0 rad for H.N. Experimentally obtained retention and excretion data were used to modify this old lung model, and slightly different doses resulted: 5.5 rad for Z.G. and 2.0 rad for H.N. A new lung model proposed by a task group of the ICRP Committee II, with particle size and rapid pulmonary clearance rate values adjusted to fit the data collected produced doses of 6.8 rad for Z.G. and 2.2 rad for H.N. Lower large intestine doses from the rapidly cleared majority of the respiratory tract burden were calculated by the same variety of methods. Results were in excellent agreement. The dose of Z.G. was found to be 3.0 rad; that to H.N. was 2.2 rad. (Disser. Abstr.)

47544 A STUDY OF THE BIOLOGICAL AND RADIOLOGICAL WASTES FROM A PRIMATE CENTER AND THEIR IMPACT UPON THE AQUATIC ENVIRONMENT. Fritschi, Engelbert Wolfgang. New Orleans, Tulane Univ., 1967. 127p.
Thesis.

The Center selected for this study is the Delta Regional Primate Research Center of Tulane University at Covington, Louisiana. A complete study of the surrounding bodies of water was made prior to the operation of the Center. This study contained all the analyses necessary for the determination of the magnitude of pollution from sources other than the Primate Center. The sampling stations extended over a six-mile stretch in the Abita River, with one control station each located in the upstream sections of the Bogue-Falaya River and in the Tchefuncte River. Samples were collected bi-weekly at these stations and analyzed for their physical, chemical, bacteriological and radioactive content for a period of eight months. Ten primates were randomly selected, representing different species and genera, for the determination of the total amount of excrements. The chemical and bacteriological analyses were performed on the total daily amount of feces and urine. Small representative samples of feces were used to demonstrate the presence of enteric parasites. The determination of the amount of wash water used for cleaning the cage area was performed by means of a commercial water meter. A flow recorder was installed for the determination of the total amount of waste water received by the Center's treatment facilities. This recorder measured flow variations from zero to forty gallons per minute. The efficiency of the sewage treatment plant was determined in terms of reduction of organic matter. In addition, bacteriological and parasitological analyses were performed to demonstrate the possible presence of pathogenic organisms in the effluent. Subsequent to these analyses, samples were collected and analyzed at the point of discharge of the treated effluent into the Abita River. Chemical and bacteriological analyses were performed for the determination of the impact of the treated effluent upon the water quality in this stream. The distribution of radioactive material in the sewerage system and in the streams was determined by the subsequent release of ^{131}I and ^{32}P at a point in the Delta Primate Center. Samples were collected at various points in the sewage treatment plant and in the Abita River at distinct time intervals. The samples were prepared and analyzed for beta-emission as well as gamma-emission. Soil samples were collected at several control points, and each sample was cut into one-inch sections and prepared for counting. The results of the analyses of the river samples indicated the presence of pollution in these rivers. The degree of pollution seemed to increase in the rainy season. The greatest sources of the pollution were found to be the overloaded and poorly maintained sewage treatment plants serving the nearby communities. Another source of pollution was found to be the run-off from rain waters and the wild animals living in the area. (Disser. Abstr.)(TSS)

47545 DOSE DISTRIBUTIONS IN ^{60}Co PLANAR ROTATION WITH CENTER OF ROTATION AT CENTER OF PHANTOM. IV. CONSIDERATIONS ON METHODS FOR CONSTRUCTING ISODOSE CURVES FROM MINIMUM EXPERIMENTAL DATA. Onai, Yoshio; Tomaru, Teizo Nippon Igaku Hoshasen Gakkai Zasshi, 28: 178-202(May 1968). (In Japanese).

The effects of different parameters on dose distributions in ^{60}Co planar rotation with the center of rotation at the center of phantom were studied with the use of a digital computer. The parameters considered were length and width of the field, angle of rotation, shape and size of the phantom, and the penumbra of the beam. In addition, the method for calculating isodose distributions for full and partial rotation, especially the number of fields which needs to be summed in order to approximate to the true integrated dose was considered. (NSA of Japan) (TSS)

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Refer also to abstracts 47294, 47311, 47314, 47327, 47344, 47396, 47436, 47505, 47518, 47539, 47540, 47578, 47618, 47619, 47622, 47627, and 48433.

47546 A TWO-COMPARTMENT KINETIC MODEL: RIGOROUS AND APPROXIMATE SOLUTIONS. Shimmins, J.; Allison, A. C.; Smith, D. A.; Speirs, C. F. (Western Infirmary, Glasgow). Calcified Tissue Res., 1: 137-43(1967).

An approximate solution of a 2-compartment kinetic model was found for use in radioisotope studies employing a whole-body counter. The model allows exchange of tracer between the 2 compartments, and loss of this tracer from 1 compartment. This solution was used to calculate the turnover rates of the 2 compartments from the retention of the tracer in the model. Hence, by measuring in a whole-body counter the retention of an isotope tracer in such a system, it is possible to calculate the turnover rates of the 2 compartments of the system. Using an English Electric KDF 9 computer to solve 64 stated models, it was possible to define the range of kinetic constants over which the use of the mathematical approximation is justifiable. (BBB)

47547 DEPENDENCE OF THE RADIOSENSITIVITY OF RATS ON INDIVIDUAL DIFFERENCES IN THE CALCULATED AND ACTUAL OXYGEN CONSUMPTION. Novak, L.; Pospishil, M.; Goshek, B. (Inst. of Biological Physics, Brno). Radiobiologiya, 8: 152-4(1968). (In Russian).

Male Wistar rats in two groups, 45 to 60 days old and 95 to 105 days old, after measurement of their respiratory metabolism level were irradiated at doses of 600, 675, and 800 R at 50 R/min for the respective groups. They were then kept in isolation without limitations on food or drink. The animals were weighed daily and deaths were recorded. The results confirmed previous data on variation of body weight after nonlethal exposures as a function of the difference between the oxygen consumption measured in an experimental animal before irradiation and the theoretical consumption calculated from the minimum requirements of the organism to maintain thermal homeostasis. (JPRS)

47548 TWENTY YEARS AFTER HIROSHIMA. Thomson, Alexander P. D. Cent. Afr. J. Med., 13: 120-4(May 1967).

Certain aspects of biology, biochemistry, and physics are reviewed as bases for understanding radiation injuries. Effects of radiation at levels of 200, 700, and 800 R as whole-body doses on production of early radiation sickness and death, delayed radiation sickness and death, effects on the gastrointestinal tract, blood-forming organs, and skin, genetic and developmental injuries produced by fetal irradiation at various intervals of pregnancy, defects of reproduction, induction of tumors by irradiation, and effects of radiation on genes of reproductive cells are discussed and summarized. (BBB)

47549 STUDIES ON THE TREATMENT OF THE RADIATION SYNDROME IN SMALL AND LARGE ANIMALS. Morczek, Adolf; Schmidt, Wolfgang (Medizinische Akademie, Magdeburg, Ger.). Strahlentherapie, 136: 200-3(1968). (In German).

Previous studies with 16 animals showed that the Vietnamese pig was a well suited animal for radiobiological studies. Thirty-one new animals received whole-body irradiation, with skin doses of 300, 400 and 500 R. The object was to study the effect of Vitamin B_{12} on the acute radiation syndrome in this animal and to compare it with the effect observed in small animals. In small animals vitamin B_{12} allowed, with sublethal doses, a rapid recovery of the syndrome and of the hematological modifications, as a study with 192 total body irradiated rats showed. Ninety-six animals received vitamin B_{12}. A similar effect of vitamin B_{12} could not be demonstrated in the Vietnamese pigs as far as survival and hematological modifications were concerned. (auth)

47550 FALLACIES OF PREOPERATIVE RADIATION. Batley, Frank (Ohio State Univ. Hospital, Columbus). Arch. Otolaryngol., 87: 456-60(May 1968).

Radiobiologic aspects of preoperative irradiation therapy were discussed and some clinical experiments reported. There was experimental evidence that the radiosensitivity of the cells was partly dependent on their oxygenation and, because the centers of malignant tumors tend to be anoxic, they are relatively radioresistant. Therefore, peripheral cells which were well oxygenated respond better than the central cells. Radiotherapy may leave a central nidus of viable malignant cells which were protected by their anoxic state and later proliferated. The combination of radiotherapy followed by surgery gave the best results, since the cells which were difficult for the surgeon to remove were sterilized by the radiation, the cells which were difficult for the radiotherapy to destroy were excised. Types of preoperative radiation were: 1000 Rad in a single treatment with surgery following the same day; 2000 Rad given over three days with surgery following with minimum delay; 4500 Rad fractionated over four weeks with surgery following after six to eight weeks; and treatment to radiation tolerance with 6000 Rad in five weeks with surgery following in six to eight weeks. Methods three and four allow maximum regression of the tumor, the operation being performed

before fibrosis occurred to interfere with the surgical dissection. With methods one and two these short courses were almost as effective radiobiologically and cells that were irradiated received the full lethal effect, the reaction of the normal tissues in removing damaged cells being slight. The interval before excision following concentrated preoperative radiation is important, and six days may be optimal, allowing the transient hyperemia to decrease. Preoperative radiation was supported by animal experiments. With tumors occurring in man there were problems of advanced disease and senility, which made this technique hazardous. (BBB)

47551 PREOPERATIVE RADIATION. Cady, Blake. Surg. Gynecol. Obstet., 126: 1091-1105(May 1968).

Theoretical, experimental, and clinical data are reviewed which indicate the safety and effectiveness of low-dose preoperative radiotherapy. High doses of radiation in the therapeutic range, when combined with radical operations, carry a considerably increased rate of surgical morbidity and, on occasion, surgical mortality. No clear clinical evidence of adverse effects in terms of surgical morbidity with low dose adjunctive radiotherapy has been published. Animal studies confirm this lack of complications, although a few reports demonstrate an increased incidence of pulmonary metastases. No clinical or experimental evidence exists to indicate that low dosage preliminary therapy significantly interferes with wound healing. Technical problems in the conduct of operations are not increased by low dose adjunctive radiotherapy. With radiation dosage in the therapeutic range, special techniques and careful timing of operations may obviate many complications usually encountered. (BBB)

47552 PULMONARY SCINTIGRAPHY AFTER ADMINISTRATION OF ISOTOPE AEROSOLS: A COMPLEMENT TO PULMONARY SCINTIGRAPHY AFTER INJECTION OF MICROAGGREGATES. Dumon, J.-F.; Brouillet-Gabriel, M.-T.; Leonardelli, M.; Paulin, R.; Charrier, J. P. (Hopital Salvator, Marseille). Presse Med., 75: 1293-6(May 24, 1967). (In French).

A new radioisotope method was developed to examine pulmonary respiratory function. Conventional pulmonary scintigraphy showed only circulation patterns in the lung. For the new method, radiogold (^{198}Au) in colloidal suspension was chosen, because of its short half life and its low-energy γ emission. To avoid contamination of workers, a modified aerosol apparatus was used. The duration of the aerosol treatment was from five to ten min using 1 to 1.5 mCi of ^{198}Au according to the patient's size. It was calculated that 20% of the aerosol inhaled became fixed in the bronchial area, at least 70% was exhaled, and the rest deposited in the mouth and pharynx to be swallowed. Thus the patient retained no more than 200 to 300 μCi. Improved lung scanning was introduced with the use of ^{99m}Tc for the normal pulmonary scintigraphy instead of radioiodine, since the half-life of ^{99}Tc is very brief, so that it can be used on the same day as the ^{198}Au aerosol. These experiments, with pulmonary scintigraphy after isotope aerosol inhalation, were considered to be successful. (BBB)

47553 ROLE OF SUPERFICIAL RADIOTHERAPY IN THE LOCAL TREATMENT OF ACNE VULGARIS. Aron-Brunetiere, R.; Nadal, R. Presse Med., 75: 1689-92(July 8, 1967). (In French).

Prevention of radioinjury and late complications was considered in the use of special techniques for superficial radiotherapy in the local treatment of acne. The literature was reviewed and it was established that a total dose of 1000 R fractionated into doses of 85 R once a week is the maximum possible with safety. A clinical study was undertaken of 150 patients with severe acne which had previously been treated by other means. X irradiation was used (100-kV, with a 1- to 2-mm Al filter). The total number of applications was six for nearly all patients, representing a total dose of 750 R, except in three cases. Results were analyzed according to age, previous treatment, and type of acne. Radiotherapy produces an effect for up to two months after treatment. In the 12- to 19-age group there were 20 cases of relapse or after-effects out of 46 patients. It was concluded that it was unwise to use radiotherapy in this age group. It was also concluded that a long period of surveillance is necessary because, although cures are quickly effected, after-effects may develop later. It was considered effective in the majority of cases (excluding the under-19 age group) and was recommended for use if other methods of cure are not effective after five months. (BBB)

47554 INFLUENCE OF PROTECTORS ON THE IRREVERSIBLE COMPONENT OF RADIATION INJURY. Yarmonenko, S. P.; Ol'shevskaya, O. P.; Shmakova, N. L. (Inst. of Labor Hygiene and Occupational Diseases, Moscow). Radiobiologiya, 8: 95-100 (1968). (In Russian).

Mexamine, AET, MEA, and cystophos were administered to white mice and rats (150, 75, 150 and 350 mg/kg to mice and 100, 15, 100 and 350 mg/kg to rats) intraperitoneally 10 min before irradiation with a single dose of x rays (180 kV), ^{60}Co γ rays or 680 MeV of protons. Examinations were made in the first mitosis: in the bone marrow 12 to 24 hr after irradiation and in the liver 30 hr after partial hepatectomy carried out one day after irradiation. The radiosensitivity of liver and bone marrow cells differed little on the basis of chromosome aberrations; each had 15 to 20% aberrant cells per 100 R. Mexamine was almost identically effective in protecting both types of cells, whereas the thiol protectors were ineffective with respect to liver cells. The possible role of radiation injuries of the chromosomes in the formation of the irreversible component of damage to the organism was examined. In actively proliferating tissues it was manifested in both acute and remote effects of irradiation, but in tissues with low physiological regeneration, mainly caused remote aftereffects. (JPRS)

47555 STUDIES ON THE RADIOSENSITIZING EFFECT OF 6-AZAURACILRIBOSIDE IN RELATION TO THE PERIOD OF INFLUENCE IN EHRLICH CARCINOMA. Magdon, Erwin; Konopatzky, Ruth; Sterescu, Marina (Robert-Roessle-Klinik, Berlin, Inst. for Oncology, Bucharest). Strahlentherapie, 136: 237-40(1968). (In German).

The influence of the time interval between administration and irradiation upon the effect of 6-azauracilriboside on cellular radiation damage was investigated. In the case of Ehrlich carcinoma, the maximum radiosensitizing effect was obtained when the substance was administered 24 hours prior to irradiation. The radiosensitizing effect of 6-azauracilriboside was due to a partial synchronization, during the course of which the cells passed through a phase with maximum sensitivity. (auth)

47556 WHICH RADIOISOTOPES FOR BRAIN SCANNING? Di Chiro, Giovanni; Ashburn, William L.; Grove, Arthur S. Jr. (National Inst. of Health, Bethesda, Md.). Neurology, 18: 225-36 (Mar. 1968).

By repeated brain scans on the same patient using a different tracer for each brain scan, the relative merits of various radiopharmaceuticals that contain ^{99m}Tc, ^{131}I, ^{197}Hg, or ^{203}Hg can be assessed. The radioisotope having the lowest energy should be administered first in order to avoid degradation of the image due to secondary scatter from a previously administered higher energy radioisotope. The current sequence is to employ ^{197}Hg-chlormerodrin for the first scan following with one or more of the other tracers in the order: $^{99m}TcO_4^-$, ^{99m}Tc-HSA, ^{203}Hg-chlormerodrin, ^{131}I-HSA (human serum albumin), and ^{131}I-rabbit antibody to human fibrinogen. When more than one tracer is employed, the accuracy of the scanning procedure increases. Among the commonly used radiopharmaceuticals there was no clearly best tracer for brain scanning. However, $^{99m}TcO_4^-$ was considered a reasonable choice for an initial screening brain scan. (BBB)

47557 PROLONGATION OF POSTIRRADIATION SURVIVAL BY DIVERSION OF INTESTINAL CONTENT. Hiatt, Nathan; Morgenstern, Leon; Warner, Nancy E. (Cedars-Sinai Medical Center, Los Angeles). Radiat. Res., 35: 301-10(1968).

Diversion of the intestinal contents by converting 95% of the small intestine into a T-V fistula 3 to 5 days before x irradiation of the abdomen (1500 R) prolonged the survival time of dogs receiving such lethal irradiation. Following irradiation, intact and operated controls succumbed by the third or fourth day. T-V fistula animals survived for at least eight days, with one alive for over three months. Radiation enteropathy in the isolated loops was less intense than that seen in the small intestines in continuity in the same animals. Loss of fluid through the T-V fistulas was negligible, and the loss per rectum of these dogs was also less than that of the controls. Leukocytosis associated with cellularity of rib, sternal, and lumbar vertebra marrow occurred after the fifth day in the T-V fistula dogs. In the control animals there was no leukocytosis. There was cellularity of the rib and sternal marrow, but the marrow of the lumbar vertebrae (within the radiated field) was hypocellular. (auth)

47558 ON THE MECHANISM OF RADIOSENSITIZATION BY 5-BROMOURACIL. STUDIES ON ^{60}Co-GAMMA IRRADIATED PHAGE ΦX-174 AND ITS SINGLE-STRANDED INFECTIOUS DNA. Hotz, G. (Kernforschungszentrum, Karlsruhe, Ger.). Mol. Gen. Genet., 102: 44-9(1968).

Experimental evidence for the sensitization of broth-suspended phage ΦX-174 and its single-stranded infectious DNA by incorporation of 5-bromouracil (BU) against ionizing radiation is given. No influence of phage protein or molecular DNA-structure on the amount of BU-damage was observed. The absence of desensitization by radical-scavenging compounds like cystamine in single-stranded DNA is discussed. It was deduced from the experimental data that host-cell and/or phage depending reactivation processes were involved in sensitization and desensitization of BU-DNA. (auth)

47559 EFFECT OF CYSTAMINE AND MAGNESIUM IONS ON MODERATE λ PHAGE INDUCTION INDUCED BY X RAYS. Guberniev, M. A.; Ryadovoi, G. V.; Rybakov, N. I.; Kolobov, A. V.; Moiseev, E. A. (Inst. of Experimental Biology, Moscow). Radiobiologiya, 8: 82-8(1968). (In Russian).

Four-hour bouillon cultures of lysogenic cells of Escherichia coli K-12 (λ) and one-day indicator strain E. coli C-85 were x-irradiated at a dose of 4000 R at 67.5 R/sec. The modifying effect of Mg ions on phage induction caused by ionizing radiation was studied and it was shown that Mg was necessary not only for intracellular development of the bacteriophage but also for its induction by the action of ionizing radiation on lysogenic bacteria. The complete removal by Mg ions of the anti-induction effect of cystamine on lysogenic bateria was reproduced. It was proposed that one of the possible mechanisms of the radioprotective action of cystamine was the binding by the protector of Mg ions in the bacterial cell. (JPRS)

47560 UV-SENSITIZATION OF PHAGE ΦX-174 BY 5-BROMOURACIL. Hotz, G. (Kernforschungszentrum, Karlsruhe, Ger.). Mol. Gen. Genet., 102: 39-43(1968).

Experimental evidence for the sensitization of buffer-suspended phage ΦX-174 by incorporation of 5-bromouracil against uv light of 2,537 Å is given. The significance of missing desensitization by radical-scavenging compounds like cysteamine in single-stranded DNA is discussed. It is concluded tentatively that host-cell and/or phage depending reactivation processes are involved in sensitization and desensitization of BU-DNA. (auth)

47561 INFLUENCE OF CYSTAMINE ON BLOOD VESSEL TONUS BEFORE AND AFTER IRRADIATION. Bachurina, T. I. (Academy of Military Medicine, Leningrad). Radiobiologiya, 8: 92-4(1968). (In Russian).

Isolated rabbit ears from four groups: intact animals, animals administered cystamine, irradiated animals, and irradiated animals that had received cystamine; (irradiation at a dose of 800 R at 24.8 R/min) were tested by the perfusion method. There were no substantial differences in perfusion between intact animals and irradiated animals that had received cystamine. Weakening of the vasoconstrictive reactions of the rabbit ear, usually observed in the period of primary reaction to irradiation, could be connected with the spasmolytic and adrenolytic action of cystamine. (JPRS)

47562 ISOTOPE RENOGRAPHY ON PARTURIENTS. Laakso, Leo (Turku Univ., Finland). Acta Obstet. Gynecol. Scand., 46: Suppl. 5, 1-104(1967).

The use of radioisotopes to diagnose renal disorders in pregnant women was extensively reviewed, including a discussion of absorbed doses of maternal organs and the fetus and the attendant hazards. An injected dose of 5 μCi of ^{131}I-Hippuran caused a radiation exposure of the kidney of 2 mR. A 14-μCi dose of ^{131}I in the bladder caused a radiation dose of 9 mR in 24 hr to the ovaries that were 5 cm from the source of radiation. However, the ovaries receive lesser amounts of radiation if the bladder was emptied several times during this period. No activity was found in a fetus aged two months, 24 hr after injecting ^{131}I into the mother. In the use of ^{131}I-Hippuran, the radiation dose to the fetal organs in pregnant women was 2 mR to the kidneys and 0.5 mR to the gonads. This dose is about a 10,000th that in intravenous urography. The radiation dose of excretion urography is 436 mR for the maternal gonads. Hence, the radiation exposure from ^{131}I-Hippuran is 1 to 2% of that from urography. The ICRP proposed a total of 1 R as the maximum permissible radiation dose during pregnancy. The dose to the gonads of a male fetus in vertex presentation during pelvimetry was estimated at 1 to 4 RAD. (BBB)

47563 LASER IN MAXILLOFACIAL SURGERY: PRELIMINARY INVESTIGATIVE SURGERY. Goldman, Leon; Shumrick, Donald A.; Rockwell, R. James Jr.; Meyer, Robert (Children's Hospital Research Foundation, Cincinnati). Arch. Surg., 96: 397-400(Mar. 1968).

The effects of laser radiation on tumors of the face and precautions that must be employed in irradiation of this area are reported. The chief hazard of the laser for maxillofacial surgery was the danger to the eyes, because the laser beams could be focused by the lens of the eye, and absorbed by the pigmented retinal epithelium producing severe burns. The possibility of the investigative use of such instrumentation in this field, its safety programs, and the need for controls and detailed follow-up studies were emphasized. Laser safety programs must include eye protection, control of laser transillumination of soft tissues, and control of plume fragments. The maxillofacial lesions for clinical study included tattoos, angiomas, and pigmented tumors that absorbed laser radiation more effectively. Adequate target areas, energy and power densities, and controls were necessary. (BBB)

47564 PREOPERATIVE RADIATION. Cady, Blake. Surg. Gynecol. Obstet., 136: 851-65(Apr. 1968).

The radiobiologic principles of preoperative radiotherapy, clinical and experimental data supporting these principles, and complications that may arise as a result of surgery after irradiation are reviewed. Whether radiotherapy is more effective when applied before rather than after surgical measures is controversial. This question was considered during the presentation of the theoretical background of preoperative radiation therapy. Recent advances in theoretic radiobiology that have altered many concepts about the action of ionizing radiation and bear on the concept of preoperative radiotherapy are discussed. The theoretic advantage of preoperative radiation over postoperative radiation relates to the factor of anoxia. Immediately after an operation, residual malignant cells lie in tissue fluid in a relatively hypoxic state similar to ascitic fluid in the mouse, while later they would be incorporated into scar tissue and also be relatively hypoxic. It was demonstrated that the protective effect of anoxia occurs almost instantly in cells deprived of their normal oxygenated environment. One method of overcoming some obstacles to the effective kill ratio is to increase the single doses of radiation. An added factor in controlling local recurrence after excision of the malignant tumor is the tumor-bed effect. Offered alternate areas of irradiated and nonirradiated tissue in which to expand, transplanted tumors preferentially grow in nonirradiated normal host tissue. Experimental studies that were carried out in small animals to show the effect of using preoperative radiotherapy on transplantable tumors are reviewed. The problems of operating on tissues previously heavily irradiated are discussed. The advent of higher energy radiotherapy has reduced many problems with skin necrosis, since this tissue is relatively unaffected by supervoltage techniques. (BBB)

47565 THE USE OF THE SUPRAMOLECULAR STRUCTURE OF DNP FOR STUDYING THE RADIO-PROTECTIVE PROPERTIES OF CHEMICAL COMPOUNDS. Seleznev, A. F.; Andrianov, V. T. (Belorussian Univ., USSR). Zdravookhr. Beloruss., No. 5, 47-8(1967). (In Russian).

The deoxyribonucleoprotein (DNP) property of forming oriented quaternary structures was used to assess the effect of protective agents on the formation of these structures when a solution of DNP was irradiated in doses ranging from 0.5×10^3 to 23×10^3 R. The protective agents studied were β-mercaptopropylamine (MPA), S-β-aminoethylisothiouronium bromide (AET) and ethyl alcohol in various concentrations. The addition of these protectors to the DNP solution was found to induce the retention of the structurization property up to various maximum irradiation doses. The model employed may be useful for finding new protectors. (ATD)

47566 INVESTIGATION OF SOME PROTECTORS FOR THE QUATERNARY STRUCTURE OF DNP. Andrianov, V. T.; Seleznev, A. F.; Pisarevskii, A. N. (Belorussian State Univ., USSR). Dokl. Akad. Nauk BSSR, 11: 434-5(1967). (In Russian).

The anterior tibial muscle was incised in 30 white rats weighing 150 g. Animals were divided into four groups: unirradiated; irradiated at a dose of 3 kR; administration of cystamine; and administration of cystamine, local irradiation for two hours and, after two more hours, injury of the irradiated muscle. The cystamine caused some improvement in the course of recovery of the locally irradiated skeletal muscle and therefore had some radioprotective effect, although slight, on the muscle tissue. (JPRS)

47567 INFLUENCE OF CYSTAMINE ON THE POSTTRAUMATIC REGENERATION OF LOCALLY IRRADIATED SKELETAL MUSCLES. Klishov, A. A.; Ivanov, A. I. (Academy of Military Medicine, Leningrad). Radiobiologiya, 8: 58-61(1968). (In Russian).

The effect of radiation on deoxyribonucleoprotein (DNP) and possible chemical protection from radiation were examined in studying the disturbance of the hereditary mechanism of cells by x radiation. The nucleoprotein and then the oriented quaternary DNP structures were prepared and subjected to 950 R/min irradiation. The critical dosage for quaternary structure formation in the 0.04% DNP solution was 1000 R. This critical dosage was greatly increased by the addition of β-mercaptopropylamine or s-β-aminoethylisothiouronium bromide, and depended on the concentration of the protector. However, when the protector concentration exceeded 0.05 mole the quaternary structure was not formed, indicating that the structure formations from which quaternary structures are subsequently obtained are not formed directly during addition of the protector. (ATD)

47568 LEUKEMIA OF THE VULVA (THERAPEUTIC AND RADIOBIOLOGIC CONSIDERATIONS). Barchet, S.; Janovski, N. A. Gynaecologia, 163: 77-91(1967).

The incidence of vulvar leukemia is infrequent. Initial therapy was given on five separate days in five equal increments. The calculated skin exposure was 744 R, and 500 R at 2 cm depth. Irradiation was given again twice. Labial skin exposure on the left was 406 R and at 2 cm depth the exposure was 363 R. The total skin exposure was 1150 R to the left labium, the surrounding area outside the given field size having been shielded. The entire left labium majus with the adjacent mons pubis and the skin of the superior mesial thigh became a massive, confluent, necrotic, foul-smelling, painful ulceration. The right labium majus in turn became swollen, edematous, enlarged, and erythematous with multiple small superficial weeping ulcerations. The patient expired six months following the initial establishment of the diagnosis of acute myeloblastic leukopenic leukemia. The leukopenia persisted throughout the course of the disease. At no time was there a significant hematologic remission. Variable degrees of radiation effects were observed on histological examination of the ovaries, oviducts, and cervix. The development and progress of necrotizing process was facilitated by the radiation therapy. The effects of ionizing radiation included minimal depigmentation, mild to moderate epilation, epidermal vesiculation, secondary infection, and the epidermis in the most extensively involved areas showed marked atrophy. Nuclear pyknosis and cytoplasmic vacuolization were observed in the malpighian layers. An area of dermal-epidermal separation and subepidermal edema was noted. The changes in the dermis were profound. There was marked stromal connective tissue edema, pronounced telangiectasia of the capillaries and lymphatics, and mild perivascular fibrosis of the larger vessels. In the dermal appendages the most vulnerable elements were the apocrine sweat glands, showing complete destruction and desquamation of the lining epithelial cells, and forming in places, large, poorly defined cystic structures. The next in order of damage were the eccrine sweat glands. They showed vacuolar degeneration and nuclear pyknosis of the lining epithelium. Areas of necrosis or epithelial desquamation were not observed. The most resistant element was the sebaceous gland, whose response to the radiation damage was manifested by a process of metaplasia. The individual sebaceous cells showed a considerable degree of keratinization. The matrix cells of hair shafts revealed vacuolar degeneration of the epithelial cells, marked nuclear pyknosis and considerable interstitial edema. The myelineated nerves of the dermis showed perineural edema and fibrosis. The nerve fibers showed disruption and vacuolar degeneration. (BBB)

47569 TREATMENT OF RADIATION INJURY. Andrews, G. A. (Oak Ridge Inst. of Nuclear Studies, Tenn.). J. Miss. State Med. Ass., 7: 534-8(Oct, 1966).

The human response to large doses of ionizing radiation and its treatment are reviewed. There is little experience in humans with doses in the extremely high range; that is, above 3000 or 4000 rad. On the basis of animal studies the consensus was that the most obvious manifestations would be those of damage to the central nervous system and that survival would not be more than two or three days. In two clinical experiences involving such high doses, in addition to neurological manifestations, there were profound cardiovascular effects with a state of shock a major factor. At slightly lower doses the effects were mainly gastrointestinal, and patients were likely to die within 10 days, of electrolyte imbalance and infections. At still lower doses of 1000 rad or less, the chief manifestations were related to the hematologic system. A profound depression of the bone marrow resulted in hemorrhage and infection, and these were the most likely causes of death. When death occurred as a result of hematologic depression, it was usually from the third through the fifth week after exposure. The hematologic type of damage was the most common in human experience, and radiation accidents, experience in outer space, and even most of the potential military exposures would likely involve these dose levels rather than the much higher ones that produce chiefly gastrointestinal or central nervous system manifestations. Use of bone marrow transplantation was considered. Effective therapy consisted of general factors such as rest and adequate nutrition, and protection of the patient from exogenous infection. Antibiotics were highly effective in treating infections that occurred. It was probably not advisable to try to advance to sterilize the gastrointestinal tract with antibiotics. At present the best opinion was that this should not be done unless a sterile environment could be provided. The prophylactic use of antibiotics was questionable in these patients, and much more information was needed about it. However, there was no question about the advantage of treating a known infection once it existed. The other major manifestation, hemorrhage, was treated by giving platelets from healthy donors. (BBB)

47570 CONTENT OF FREE SEMIQUINOID RADICALS AND THEIR PREDECESSORS IN MAMMALIAN TISSUES WITH DIFFERENT RADIOSENSITIVITY. Kuzin, A. M.; Yarygina, G. I. (Moscow Technological Inst. of the Meat and Milk Industry). Radiobiologiya, 8: 158-9(1968). (In Russian).

Tissues of the brain, muscle, kidneys, lungs, liver, and spleen of the bull, ram, and sow were frozen with liquid nitrogen and lyophilized to a moisture content of 1 to 2%. The EPR method was used to determine the quantity of free semiquinoid radicals in the tissues and the dynamics of their increase in the presence of moistened oxygen, which reveals the quantity of their predecessors capable of giving free semiquinoid radicals during oxidation. The results showed that decrease of susceptibility to radiation injury during irradiation correlates well with reduction of such predecessors. (JPRS)

47571 SOME BIOCHEMICAL PECULIARITIES OF COMBINED ACTION OF ULTRAVIOLET AND ROENTGEN RAYS ON AN ORGANISM. Baraboi, V. A.; Zagoruiko, L. I.; Ostrita'ka, L. M.; Fialek, V. Yu. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 504-13(July-Sept. 1968). (In Ukrainian).

To investigate the mechanisms of the prophylactic influence of repeated uv irradiation on the lethal effect of x rays, the changes in glucose content, blood cholinesterase activity, and excretion of 17-oxycorticosteroids in guinea pig urine were studied under one- and 12-fold (by one biodose) uv irradiation followed by x irradiation. It was established that the repeated action of uv rays affected the reactivity of mammalian organisms in such a way that a more quiet, slower, and less manifested reaction to the lethal x ray dose effect was observed in the form of hyperglycemia, cholinesterase activity decrease, and excretion of corticosteroids. Thus, according to our data, a prophylactic effect of repeated uv irradiation of animals with uv rays of an erytheme range consisted in somewhat of a decrease of organism reactivity, in a peculiar adaptation to the ray factor action. (auth)

47572 TREATMENT OF SKIN AND MUCOUS MEMBRANE REACTIONS CAUSED BY RADIOTHERAPY. Hoermann, D.; Pfeiffer, J. (Karl-Marx-Univ., Leipzig). Med. Klin. (Munich), 61: 1971-3(Dec. 9, 1966). (In German).

A local anesthetic compound, N-N-bis-(N-methyl, N-phenyl-t-butyl-acetamido)-β-hydroxyethylamine, known as oxethazaine, or by other, similar names was used to treat complications in 73 patients who were x irradiated for treatment of oral, laryngeal, pharyngeal, gynecological, and other types of tumors. The x-irradiation complications consisted of pain in swallowing, mucous membrane burns, colitis, proctitis, and various exudative reactions. The oxethazaine was given repetitively by oral administration, applied in a wet compress, or used as an emulsion with incutin. Improvement in swallowing was found in ~50% of the patients. Mucous membrane burns were favorably affected in ~30%. of the cases treated, the colitis-proctitis cases were improved in 50% of the cases treated, and ~60% of the various exudative reactions responded favorably. Results depended on the type of reaction treated and the physical method of application of the oxethazine. (BBB)

47573 VARIATION OF THE OSMOTIC STABILITY OF LEUKOCYTES FOLLOWING RADIATION AND INJECTION OF BONE MARROW AND SYNESTROL. Pareishvili, E. A.; Kheifets, Yu. B.; Sinanyan, N. O. (Ministry of Health, Erevan). Radiobiologiya, 7: 835-9(1967). (In Russian).

Mature male white mice weighing 18 to 20 g received a total single irradiation of 650 R at 33 R/min. Apart from the control groups, one group received injections of bone marrow every 24 hours after irradiation, and another group Synestrol prophylactically once seven days before irradiation in 0.1 ml of 2% oil solution. The animals were examined one, five, seven, nine, 11, 13, 15, and 28 days after irradiation. During the 28-day period, injections of bone marrow increased the osmotic stability of the leukocytes (it returned to the original level in two hours); Synestrol did not increase that stability. Cytolysis of the blood cells was much less intense after administration of bone marrow than after administration of Synestrol, and the number of leukocytes also was much higher after receiving bone marrow than in the control group. (JPRS)

47574 RADIATSIYA I KHIMICHESKAYA ZASHCHITA. (Radiation and Chemical Protection). Romantsev, E. F. Moscow, Atomizdat, 1968. 248p.

A brief review is given of concepts of primary physico-chemical processes induced in cells by ionizing radiation and on the measures for chemical protection against it. Effects of radioprotective preparations on the radiosensitivity of biochemical processes are evaluated and the mechanism of radioprotective effects of aminothiols, mercamine and protamine are discussed. Radioprotective effects of sulfur-bearing aminoacids, glutathione, and biogenic amines are analyzed and data on radioprotective effects of nucleic acids and various therapeutic-protective measures

are summarized. Effective properties of cyanoforms, nitrites, and aminophenols and various less known chronical protectors are evaluated. Each chapter includes references covering published data up to 1966 inclusive. (725 references.) (R.V.J.)

47575 LONG-RANGE RISKS IN TREATMENT OF HYPERTHYROIDISM BY RADIOACTIVE IODINE. Bricaire, H.; Mauvais-Jarvis, P.; Netter, A.; Vallee, G.; Pequignot, H. (Hopital Necker, Paris). Presse Med., 76: 327-30(Feb. 10, 1968). (In French).

The long-range effects of radioiodine treatment of hyperthyroidism are discussed, based on the results throughout the 25-yr period since ^{131}I was introduced. The possibility of malignancies from ^{131}I treatment is considered and dismissed as insignificant, since cases of cancer occurring in patients treated with ^{131}I show about the same incidence as for control groups. The risk of gonadal injury is also considered small, for no cases of sterility have been observed. However, it was not considered possible to evaluate accurately the risks of genetic mutation, because there is no way to predict in which generation such an effect might occur. In general, such risks are considered to be 1 in 4000 to 1 in 10,000 gametes. Optimal and safe doses for therapy of the hyperthyroid condition are discussed; from 4000 to 8000 rad is considered to be the safe range. The most prevalent and serious complication of radioiodine treatment, hypothyroidism, and its prevention and treatment are considered. (BBB)

47576 THE ATOMIC ENERGY BOARD WHOLE-BODY COUNTER AND ITS APPLICATION TO MEDICINE. van der Merwe, C. J. (Atomic Energy Board, Pelindaba, South Africa); Basson, J. K.; Jansen, C. R.; Oosthuizen, S. F. S. Afr. Med. J.; 42: 95-8(Feb. 3, 1968).

A short description of whole-body counters in general, with a brief comparison of different types, is given. The construction of the Atomic Energy Board's whole-body counter is described. This facility consists of an 8 ft. × 7 ft. × 8 ft. room with 8-in. steel walls and $\frac{1}{2}$-in. lead lining, housing the 4 in. × 8 in. NaI(Tl) scintillation counter, which feeds a 400-channel pulse-height analyser. Applications of the instrument, with particular reference to its medical uses, are discussed and some typical results are indicated. (auth)

Radiation Effects on Animals

Refer also to abstracts 47457, 47482–47485, 47489, 47492, 47503, 47515, 47520, 47521, 47526, 47538, 47547, 47548, 47561–47564, 47567–47569, 47574, 47575, and 47642.

47577 (NP-17191) REPORT OF THE UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION. General Assembly, Official Records: Twenty-First Session, Supplement No. 14 (A/6314). (United Nations Scientific Committee on the Effects of Atomic Radiation). 1966. 153p. United Nations $2.50.

A discussion of environmental radiation, both natural and artificial, and of the genetic risks arising from exposure to ionizing radiation is presented. This is followed by technical annexes (radiation from natural sources, environmental contamination, and genetic risks of ionizing radiation) on which conclusions were based. The conclusions are discussed in detail (1100 references). (B.S.L.)

47578 ACTION OF SH-CONTAINING COMPOUNDS AND OF PLASMA FROM PANTETHINE-TREATED RABBITS ON PLATELET COUNTS IN IRRADIATED RATS. De Nicola, P.; Coppi, M.; Montanaro, G. (Univ., Pavia, Italy). Farmaco (Pavia), Ed. Sci., 23: 47-51(Jan. 1968).

The following compounds containing SH groups or enhancing their synthesis were administered to irradiated, thrombocytopenic rats: pantethine, coenzyme A, methylmethionine sulfonium chloride (MMSC), and glutathione. Also, plasma from pantethine-treated rabbits with thrombocytosis was injected into irradiated rats. Adult rats, weighing about 250 g, and rabbits, weighing about 2500 g, were used. In rats 1000 R was given as a single dose; 200 R was given six days and 200 R eight days after the first irradiation. The substances tested were injected intramuscularly into the irradiated rats as soon as platelet counts fell to values as low as 40,000/mm^3. Pantethine was administered to rabbits at a daily dose of 400 mg intravenously for 10 days. One ml of plasma from treated or from untreated rabbits was injected into irradiated rats on three subsequent days. The administration of all four substances resulted in a definite increase in platelets in irradiated rats. The effect was evident as early as one to two hr postirradiation. There was a further increase during the following days and the maximum values were reached several days after discontinuation of the treatment. The increase of platelets was more pronounced for coenzyme A and MMSC and a little less marked, although evident, for glutathione and pantethine. After the administration of plasma from pantethine-treated rabbits to irradiated rats, an increase of platelets was demonstrable as early as one hr and there was a further increase after 12 hr and during the following days, that was still evident at the 16th day after the first injection, i.e., several days after the last injection. Irradiated, untreated rats showed slight modifications of platelet counts. Plasma from untreated, normal rabbits had no effect on irradiated rats. (BBB)

47579 EFFECT OF GAMMA RAYS ON THE PROTEOLYTIC ACTIVITY OF "IN VITRO" IRRADIATED BLOOD CELLS. I. EFFECT ON POLYMORPHONUCLEAR LEUCOCYTES. Kopitar, Majda; Cotic, Vladimir; Turk, Vito; Lebez, Drago (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). Strahlentherapie, 135: 714-17(June 1968).

Polymorphonuclear rabbit leucocytes were irradiated in vitro at 37°C in a suspension of 50% autologous serum in Hank's buffer (pH 7.4). Proteolytic activity of polymorphonuclear leucocytes (irradiated and unirradiated) was followed. The effect of dose range from 200 to 1200 R gamma irradiation on polymorphonuclear cathepsins was studied 90 minutes after irradiation. A significant increase of catheptic activity was demonstrated with doses of 600 to 1200 R. The possible mechanism of the observed changes in catheptic activity after irradiation was discussed. (auth)

47580 CHANGES IN THE CONTENT OF SOME ENERGY-RICH PHOSPHATE COMPOUNDS IN MOUSE LIVER AFTER IRRADIATION IN VIVO. Waldschmidt, Marianne (Univ., Freiburg i. B.). Strahlentherapie, 135: 695-701(June 1968). (In German).

The concentration of ATP, ADP, AMP, inorganic phosphate, extralabile phosphate, and glucose-6-phosphate was measured in the liver of mice that had been totally irradiated with 690 R, between six hours and 14 days earlier. The amount of ATP diminished in fasting animals between 12 and 24 hours after irradiation and between six and 14 days, while it remained unchanged in the normally nourished animals. In both groups, neither ATP and AMP was modified. The concentration of inorganic phosphate parallelly increased with the decrease of ATP after irradiation in the fasting animals, in the normally nourished it was significantly lower than in the controls between the fifth and ninth day. The amount of extralabile phosphate (mostly carbamyl-phosphate) increased in the nourished animals between the 10th and 14th day. The amount of the five phosphate compounds was not influenced by a fasting of 24 hours. The concentration of glucose-6-phosphate after 24 hours fasting was reduced to 20% of its original value. In the liver of irradiated and fasting animals it was however significantly elevated between the 12th and the 24th hour and between the fourth and 14th day after irradiation. In nourished animals a significant increase was observed for G-6-P at 12 hours and four to five days, but a decrease at day 9, 11, and 12 after irradiation. (auth)

47581 RADIATION DOSE-TIME RELATIONS FOR INDUCTION OF BONE TUMORS IN THE DOG AND SKIN TUMORS IN THE RAT. Blair, H. A. (Univ. of Rochester, N. Y.). Radiat. Res., 34: 501-22(1968).

There are two mutually exclusive routes of tumor induction by radiation both in rat skin from brief doses of external β radiation and in dog bone from ^{239}Pu, ^{226}Ra, ^{228}Ra, or ^{228}Th injected at age 500 days. In the one process oncogenesis occurs directly on attainment of high radiation dose. In the other process oncogensis follows a long latent period that is initated by lower dose. Subsequent development time is the same in both cases. With protracted dosage the latent period is initiated at relatively low dose, but if exposure is continued the high-dose process will supersede the low if the high-dose threshold is exceeded during the latent period. Otherwise the low-dose process will govern. For those radioelements in the dog yielding relatively constant dose rates the data are represented closely by the equations $S - T = K/d$ or $S - T = 0.2K/d + 1200$ in which S is survival time in days, K is the initiating high dose, T is the development time, and d is dose rate to the skeleton. The first equation applies when $S - T$ is less than 1200 days, and the second when $S - T$ is greater than 1200 days, the low-dose latency. K and T are specific for each element. The relative values of K provide a scale of toxicities. (auth)

47582 USSR AND U.S. BIOSCIENCE. Jenkins, Dale W. BioScience, 18: 543-9(June 1968).

The USSR and U. S. programs of space biology, including effects of radiation and weightlessness, are reviewed as a background to the Biosatellite experiments. The ambient radiation levels encountered in space flights have almost always been below the threshold of observable radiation response in the large variety of organisms flown. Also, forces of launch and recovery (especially vibration and acceleration) made it difficult to distinguish the dose response at low levels of radiation, or the combined effect of ambient cosmic radiation and weightlessness. Lysogenic bacteria

(Escherichia coli) carrying temperate bacterial viruses were on nearly all USSR bioscience space flights including Sputniks 5 and 6, Vostok 1 to 6, Voskhod 1 and 2, and on Cosmos 110 as a biological dosimeter for radiation. Phage production was induced by 200 to 400 mR. Values of induced phage production for Vostoks 3 and 5 were equivalent to 3.2 rad, and about 0.8 rad for Vostoks 4 and 6. Chlorella and dry seeds of a large variety of higher plants were exposed to space flight conditions in Sputniks 5 and 6, Vostoks 1 to 5, Voskhods 1 and 2, and Cosmos 110. The absence of correlation of any effects with time of weightlessness and radiation levels indicated that vibration and acceleration in combination with radiation were the probable causes. In Drosophila, space flight resulted in a significant increase of mutations caused by chromosome rearrangement (dominant lethals) in spermatids of males, due primarily to vibration (70 Hz) and not radiation. An increased frequency of sex-linked recessive lethals was thought to be due to radiation since they were point mutations with a higher rate in the spermatids than in mature sperm. In mice, chromosome fragmentation, characteristic of radiation damage, was nearly absent. (BBB)

47583 STUDIES ON COMBINATION INJURIES. PART 10. HISTOPATHOLOGICAL STUDIES ON MICE AFTER WHOLE-BODY IRRADIATION IN COMBINATION WITH OPEN SKIN WOUNDS. Messerschmidt, Otfried; Oehlert, Wolfgang (Univ., Freiburg i. B.). Strahlentherapie, 136: 229-36(1968). (In German).

The histological studies on mice after whole-body irradiation at 510 R and with skin wounds (two days after irradiation) showed tissular changes in the lungs, kidneys, liver, and cardiac muscle. These modifications were similar to those observed in acute or protracted shock. The influence of an infection was apparently not taken into consideration. (auth)

47584 BIOSATELLITE II RADIATION-WEIGHTLESSNESS EXPERIMENTS. Warren, Shields (New England Deaconess Hospital, Boston). BioScience, 18: 570(June 1968).

Background of the space radiobiology experiments are briefly discussed. The panel on Radiation Biology of the Space Science Board recommended that a few simple, but discriminating, experiments be performed in space to ascertain whether additional experiments would have any basic radiobiological interest. The panel did not exclude the remote possibility, however, that the radiobiological response may be modified by factors unknown and perhaps not susceptible to terrestrial study. Experiments designed to settle this matter included the exposure of biological materials during space flight and met the following criteria of reliability: the use of well-known biological systems, e.g., mutation induction or chromosome breakage; the use of a sufficient number of individuals in the experiment to guarantee statistical precision of the results; the exposure of the system to known quantities and qualities of enclosed radiation; and the use of adequate controls. (BBB)

47585 IS THE PROBLEM OF RADIOTHERAPY OF CEREBRAL TUMORS STILL UNSOLVED. Lenzi, M. (Univ., Modena, Italy). Atti Accad. Med. Lombarda, 21: 193-9(July-Sept. 1966). (In Italian).

The following topics relative to the problems of irradiation of brain tumors are considered: prospects of new techniques with a new mode of action, use of high-energy particles from accelerators, use of radioisotopes, combination of antimitotic agents with radiation, radiobiologic aspects of the problem and its solution, radiosensitivity of brain structures, and early and late manifestations of radioinjury of the brain. The sensitivity of neural cells may be great; evidence indicates that doses as low as 50 to 200 R may cause damage. The recovery of nerve cells from radioinjury is relatively low. The late reaction of brain, so-called late encephalomalacia, seems to be the result of vascular impairment and nutritional privation of brain cells. The accompanying reactions in brain to tumor cell irradiation, such as exudation and edema, in the surrounding healthy tissue are discussed. The extent of the irradiated volume is highly important in brain irradiation. The question of the dose that is tolerated by neural tissue is discussed. (BBB)

47586 EXPERIMENTAL TYZZER'S DISEASE IN DIFFERENT SPECIES OF LABORATORY ANIMALS. Takagaki, Yashio (Chugai Pharmaceutical Co., Ltd., Tokyo); Ito, Masako; Naiki, Masaharu; Fujiwara, Kosaku; Okugi, Minoru; Maejima, Kazuyoshi; Tajima, Yoshio. Jap. J. Exp. Med., 36: 519-34(Oct. 1966).

Tyzzer's disease was produced in various species of laboratory animals inoculated with infected mouse liver homogenate. Hamsters, mongolian gerbils, cotton rats, red mice, and young rabbits showed multiple focal necrosis in the liver, also observed in mice when infected intravenously and treated with cortisone. X irradiation was also effective for enhancing the infection. Exposure of mice to 500 R caused almost the same enhancing effect on the infection in mice as induced by 2.5 mg cortisone injected shortly after inoculation. Rats, albino hamsters, guinea pigs, and young rabbits were exposed to whole-body irradiation of 500 R and 24 hr later were injected intravenously with 1.0×10^5 to 2.0×10^7 organisms. None of these animals died within seven days after inoculation but, when sacrificed on the seventh day, focal liver necrosis was seen in rats, hamsters, and rabbits. In nonirradiated rats and hamsters the liver lesion was of much less severity than in the irradiated animals and rabbits did not show any lesions in the liver without x irradiation. However, guinea pigs, that were resistant to the infection combined with cortisone treatment, failed to be affected even when exposed to x rays before inoculation. (BBB)

47587 CHANGES OF BLOOD PICTURE IN CHICKS IRRADIATED BY VARIOUS DOSES OF X RAYS. Kirshin, V. A.; Cheremukhin, V. I.; Verkholetov, V. A. (Inst. of Veterinary Medicine, Kazan, USSR). Uch. Zap. Kazan. Vet. Inst., 94: 54-9(1965). (In Russian).

Experiments were conducted on 100 chicks, 1 day old, equally divided into 4 groups. The 1st group received 25 R, and 2nd 100 R, the 3rd 500 R of whole-body radiation, and the 4th group was the control. Hematologic examinations of the chicks were performed 2, 5, 15, 30, 60, 90, 120, and 150 days after irradiation, and included: total serum proteins and their fractions, hemoglobin levels, counts of erythrocytes, leucocytes, and thrombocytes per mm^3 of blood, and the no. of cells in 1 mm^3 of bone marrow samples, differential leukocyte counts, and myelogram. Blood specimens were taken from the subaxillary vein and bone marrow from the femora. The most pronounced changes in peripheral blood (none were seen in the 1st group) were noted in leucocyte counts of chicks of the 2nd and 3rd group 15 days after irradiation. The number of lymphocytes decreased considerably, and lymphocytes in chicks of the 3rd group were small and had pycnotic nuclei. In the 2nd, and particularly in chicks of the 3rd group, subsequent examinations revealed hypersegmented pseudoeosins, and monocytes and lymphocytes with vacuolated cytoplasm. The erythrocyte count, hemoglobin and color index in chicks of all groups showed no changes during the experiments. The 1st group exhibited some increase of total serum protein and in the globulin fractions, while the 2nd group showed decreased globulins after 120 postirradiation days. The 3rd group showed fluctuations with a decrease that was only slightly below the control level. The bone marrow in the 1st group 60 days after irradiation had an increased content of erythroblasts and of mature forms of myeloid cells. The 2nd group after 60 days and the 3rd group after 5 months revealed a decreased no. of cells in 1 mm^3 of marrow sample. The 3rd group also showed a decreased number of immature cells, myeloblasts, promyelocytes, myelocytes, metamyelocytes, and stab nuclear forms. (BBB)

47588 INACTIVATION OF TISSUE THROMBOPLASTIN BY ULTRAVIOLET IRRADIATION. Atland, S.; Hvatum, M.; Prydz, H. (Univ. of Oslo). Throm. Diath. Haemorrh., 19: 221-5 (Mar. 31, 1968).

The importance of the protein components for the biological activity of tissue thromboplastin was investigated by irradiating solutions of purified thromboplastin with uv light of different wavelengths. The efficiency of uv radiation in destroying the procoagulant activity was measured. In solutions of human brain thromboplastin irradiated with uv light the procoagulant activity decreased as an exponential function of the dose. The action spectrum obtained was closely similar to the uv absorption spectrum of the thromboplastic preparations and had a maximum between 270 and 290 nm. The absorption of uv light due to the lipid part of the thromboplastic structure was probably negligible in the 250 to 290 nm region. The possibility that the loss in procoagulant activity was caused by isomerization of unsaturated fatty acids is unlikely. Such isomerization would create systems of conjugated double bonds resulting in an increased absorption at 280 nm, but no changes in the absorption spectrum or in the extinction coefficient were found after irradiation. It was therefore concluded that the photons, at least in the 270 to 290 nm region, were absorbed by aromatic amino acids in the protein part of the thromboplastic entity, resulting in a reduction of the procoagulant activity of the preparation. The protein part of the thromboplastic structure thus probably is of importance for coagulation activity. (BBB)

47589 FERTILITY OF MICE AFTER FRACTIONATED AND PROTRACTED RADIATION DURING GESTATION. Langendorff, Hanns; Langendorff, Margarethe (Univ., Freiburg i. B.). Strahlentherapie, 136: 220-8(1968). (In German).

Gravid mice were irradiated during their complete gestation period (20 days) with high doses at different fractionation and protraction schemes. The fractionated irradiation seemed three to four times more effective than irradiation of the gravid animals at low dose rates as can be judged from the comparison of the

reproduction capacity of the parents. However only a small difference could be detected when comparing the reproductive capacity of the F_1-animals irradiated in utero at different fractionation or protraction schemes. (auth)

47590 EFFECTS OF SMALL DOSES OF PENETRATING RADIATIONS ON THE CORTICOSUBCORTICAL INTERACTION. Antropov, G. A.; Godin, V. P.; Kolesnikova, A. V. (Moscow Scientific-Research Inst. of Sanitation). Gig. Sanit., No. 7, 49-52(July 1968). (In Russian).

Effects of radiation on the central nervous system of rabbits were studied by noting changes in reflex activity. Small doses of γ radiation over a period of 20 hrs induced changes in reflex activity of the animals. Conditioned and unconditioned reflexes were analyzed in relation to changes in respiration and cardiac rhythm; results indicated that a pronounced excitation was produced in the subcortical region of the cerebrum. (H.L.W.)

47591 EVIDENCE OF ACTION OF NATURAL IONIZING RADIATION ON THE REPRODUCTION OF DROSOPHILA MELANOGASTER. Planel, H.; Soleilhavoup, J.-P.; Geiss, M.-C.; Tixador, R. (Faculte de Medicine, Toulouse). Compt. Rend. Ass. Anat., No. 139, 1031-5(Mar. 1968). (In French).

Possible effects of environmental levels of radiation on the reproduction of D. melanogaster were tested. An attempt was made to determine whether diminution in populations due to radiation was caused by a delay in hatching of pupae or by a definite halt in the development of embryonic or larval forms. Drosophila (Oregon strain) were raised under normal conditions in glass vials or in a protective container with lead walls 10 cm thick. A consistent delay of 24 to 48 hr in hatching was observed when shielding was used. The effect of the experimental conditions on stages of development is discussed. It was concluded that natural irradiation can influence biological activity, as shown by the delay in development at certain stages, thus confirming earlier results of studies on protozoa. (BBB)

47592 EARLY NEUROPATHOLOGICAL RESPONSES TO 2.2-GeV PROTONS IN RABBITS. Lippincott, Stuart W.; Stickley, Efmer E.; Calvo, Wenceslao; Farr, Lee E. (Medical Coll. of Virginia, Richmond. Univ. of Ulm, Ger. Univ. of Texas, Houston). Contract AT(40-1)-3515. Strahlentherapie, 136: 178-82(1968). (ORO-3515-4).

A total of 34 rabbits were bombarded to the head only with 2.2 GeV protons at fluxes varying from 3×10 to 5×10^{12} particles/cm^2. The calculated doses for these exposures ranged from 1650 to 275,000 rad. Within the 24 hours following exposure to proton radiation of 3×10^{10} protons/cm^2, no cytological alterations were seen. At 20 minutes after 1.5×10^{12} exposure, scattered pyknotic neurons were seen throughout the cortex. At 86 minutes after proton exposure to 5×10^{12} protons/cm^2 pyknosis of cerebellar granular cells appeared widespread; capillary dilatation was also seen. At 5 hours after such an exposure, most cerebellar granular cells were pyknotic with vacuolization present in some Purkinje cells; at this time, extravasation of leukocytes into the leptomeninges was noticeable, but no alterations were noted in the vascular endothelium. Hemorrhage occurred early in the third ventricle. In the cortex, perivascular fluid extravasation with leukocytes was also seen early. After 24 hours, at one order of magnitude less exposure, petechial hemorrhages and microglial mobilization were observed in the cerebrum. At 48 hours the cytological alterations were similar to those present at 24 hours. The animals exposed to the highest flux were ataxic immediately after leaving the exposure room and died between 40 minutes and 5 hours after irradiation. (auth)

47593 COMPARISON BETWEEN 200 kVp X-RAYS AND ^{60}Co γ-RAYS BY THE TESTICULAR WEIGHT LOSS OF THE MOUSE. Okamura, Shigeaki; Nakamura, Hiroshi (Kyushu Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 355-8(June 1968). (In Japanese).

A comparison of the effects of kVp x rays and ^{60}Co γ-rays (whole-body irradiation) were measured by the use of testicular weight loss of CF1 mice. The relationships between the testes weight at the 28th day after irradiation and absorbed dose were as follows 200 kVp x-rays: $W = -87.81 \log D + 294.8$, $\sigma^2 = 63.78$; ^{60}Co γ rays: $W = -73.81 \log D + 274.0$, $\sigma^2 = 24.86$, where W is the estimated testes weight and D is the absorbed dose. The equal effect ratio of γ rays as 0.7, and equal dose ratio were about 0.9 at doses of 50, 100, 200, 300, and 400 rads. There was no significant differences between the values measured by whole-body irradiation and those measured by local irradiation. (NSA of Japan)

47594 TREATMENT OF THYROTOXICOSIS. Friedmann, Paul (Roswell Park Memorial Inst., Buffalo, N. Y.). New Engl. J. Med., 278: 113(Jan. 11, 1968).

Prevention of myxedema as a complication of the ^{131}I therapy of thyrotoxicosis was discussed, particularly the proposal of reducing the initial dose of radioactive iodine in conjunction with antithyroid therapy. This concept appeared to have merit; however, the biologic effects of antithyroid drugs when given over prolonged periods after the administration of therapeutic doses of ^{131}I were largely unknown. It was pointed out that a prolonged stimulus to hyperplasia, such as is provided by some antithyroid compounds, after ^{131}I therapy, could lead to a high rate of carcinogenesis. In experiments on rats treated with methylthiouracil and radioiodine, macroadenomas developed in virtually all the rats, and thyroid carcinoma in 8%. Human thyroid cells were probably more sensitive than rat thyroid cells to the effects of radiation, though it did not necessarily follow that the effects would be the same. There was a need for critical experimental study of this problem before combined therapy with ^{131}I and antithyroid drugs was generally used for human thyrotoxicosis. (BBB)

47595 EFFECTS OF LASER IRRADIATION ON THE CENTRAL NERVOUS SYSTEM. II. THE INTRACRANIAL EXPLOSION. Fox, John L.; Stein, Marvin N.; Hayes, Jude R.; Green, Robert C. (Veterans Administration Hospital, Washington, D. C.). J. Neurol., Neurosurg., Psychiat., 31: 43-9(Feb. 1968).

When a single pulse train containing 12 to 24 cal of 694-nm wavelength laser energy and lasting 1.5 to 2.5 msec intercepted the exposed intact skull of a guinea pig, extremely high intracranial pressures exceeding 10 atm for one msec were attained. This occurred even though only 10% of the energy actually reached the brain though the skull. This led to brain-stem herniation and immediate, permanent respiratory arrest. The intracranial pressure phenomenon was studied using high speed cinematography. At focus the skull was superheated (estimated 6000°K) causing burning and vaporization of the skull to result in a one mm dia perforation. The high-speed cinematography revealed a plume of vapor and particles blown off the skull causing the head to recoil. Profile cinematography demonstrated submentovertical expansion of the entire skull for a one msec interval. Severe damage frequently occurred to the eyes, and occasionally eyes ruptured out of their sockets. Examination for evidence of blood-brain barrier injury using fluorescein tracer and uv light revealed only local injury insufficient to explain death. Calculations indicated that the outer 100 μ guinea pig brain under the point of laser skull interaction absorbed about 625 cal/g. (BBB)

47596 CONCENTRATED RADIOTHERAPY: IMMEDIATE RESULTS IN THE FIRST 50 CASES. Gest, J.; Delouche, G. (Centre Rene-Huguenin de Lutte Contre le Cancer, Saint-Cloud, France). Presse Med., 74: 2149-50(Oct. 8, 1966). (In French).

A study was made of 51 cases receiving large individual doses of radiotherapy of about 1000 to 3000 R/tumor for various epitheliomas, metastases, and as preoperative therapy. All patients were irradiated with telecobalt, either by fixed field or by rotational therapy or by pendulum. The tumor dose was calculated by a geometric study for each patient. Most patients received a 2000-R tumor dose in three visits, 700 + 700 + 600 R spread evenly over 48 hr. In most cases a second dose was given three or four weeks after the first; a 1000- to 2000-R tumor dose was received in two or three visits (over 24 or 48 hr). In cases of preoperative radiotherapy a dose of 2000 R was extended over three visits and 48 hr. One patient received 3000 + 3000 R, nine received 2000 + 2000 R, ten received 2000 + 1000 R, and nine preoperative patients a single dose of 2000 R. Almost no side-effects of radiation were observed. A few instances of nausea occurred during the three days of treatment, as well as some radiomucositis in esophagal and oral irradiation. Slight pigmentation occurred in a few patients but no other skin reactions were observed. As for late effects, after several months slight pulmonary fibrosis appeared in patients irradiated for mediastinopulmonary tumors. It was concluded that some subcutaneous and muscular side-reactions would probably occur as they have in other instances of telecobalt therapy. (BBB)

47597 SIGNIFICANCE OF HYDRONEPHROSIS IN IRRADIATED CARCINOMA OF THE CERVIX. Fernicola, Anthony R. (St. James Hospital, Newark, N. J.). J. Med. Soc. N. J., 64: 505-9 (Sept. 1967).

Radioinduced hydronephrosis in six patients receiving radiotherapy for cervical cancer was reported; three cases are described in detail. Reversibility of this condition was emphasized. The known causes of ureteral obstruction in carcinoma of the cervix were carcinomatous infiltration of the ureter and periureteral metastases, ureteral and periureteral fibrosis as sequela of parametritis and tumor necrosis, and postradiation stricture. These conditions presented an irreversible and progressive obstructive ureterecstasis and pyelecstasis. The resultant hydronephrosis was correctable by several surgical techniques; ureteroneocystostomy was the most commonly used. A distinction was made when hydronephrosis developed in patients irradiated for carcinoma of the cervix. The obstructive, irreversible ureterecstasis

and pyelecstasis were forms of hydronephrosis which were differentiated from nonobstructive, reversible ureterecstasis and pyelecstasis, which was hydronephrosis produced by an apparently reversible radiation ureteropathy. This form of hydronephrosis starts about one-half to three yr following completion of Ra or ^{60}Co therapy. These patients are virtually asymptomatic. Regression and disappearance of hydronephrosis may be seen in two to four months following initial urographic evidence of dilatation of the upper urinary tract. Presumably a radiation effect occurred in neurogenic, myogenic, or vascular elements within the lower ureteral segment to produce a temporary neuromuscular dysfunction or inactive peristalsis (the inert ureteral segment). Also, a radiation-induced parametritis which resolved spontaneously might be a factor. (BBB)

47598 CROSSWISE FLAP: CLOSURE OF LOSSES OF SUBSTANCE IN AN IRRADIATED AREA. Grignon, J. L.; Andrieu, J. (Hopital Saint-Antoine, Paris). Ann. Chir. Plast., Sem. Hop., 10: 10-17(Mar. 1967). (In French).

Results were reported of a method of closure used with 12 patients presenting losses of skin after irradiation of the cervicofacial area. Radiotherapy was used for malignant tumors of the pharynx, mouth, and nose and radiodermatitis had developed, producing epitheliomas in some cases. Classical methods of closing the radioinjured areas were inappropriate. The nature of the skin affected by dermatitis did not present a good tissue base for forming a flap and did not receive and nourish new skin. The risk of epithelioma was present after irradiation. The conditions in the particular patients concerned were extremely unfavorable. It was necessary to find a method that completely suppressed the irritated area and guaranteed it breadth of coverage and firm closure. The crosswise flap was chosen because of its adaptability. The technique was described for each case, as well as the success of its use. (TSS) (BBB)

47599 RESULTS OF RADIOTHERAPY OF CARCINOMA OF THE UTERINE CERVIX. Fletcher, Gilbert H. (M. D. Anderson Hospital, Houston, Tex.). Proc. Roy. Soc. Med., 61: 391-4(Apr. 1968).

Clinical results and complications of radiotherapy in 1705 patients with cervical carcinoma treated with Ra and 22-MeV external irradiation were reported. Stage I cases received 8000 to 10,000 mg-hr doses of Ra in two to four insertions and 3000 to 4000 RAD of 22-MeV betatron irradiation. The survival rates were 94.5% in Stage I, 65% in Stage II, and 25% in Stage III. High-dose whole-pelvis irradiation alone or combined with intracavitary Ra therapy approached the maximum tolerance. The complications due to intracavitary Ra therapy were rectal ulcers at the level of the posterior fornix, bladder ulcers, and recto- and vesico-vaginal fistulae. Rectosigmoiditis, sigmoiditis, and small bowel complications were essentially caused by external irradiation. In 1959, the change from the roentgen unit to the RAD added 7% to the dose given. This relatively small increase in dose produced a significant increase in the incidence and severity of complications. Therefore great care must be exercised in the use of whole pelvis irradiation with attention to all the factors involved, i.e., dose determination, the true size of the portal (penumbra to be considered) and the pelvic structures covered. For Stage IIB and favorable Stage IIIA cases, doses probably should not exceed 4000 RAD to the whole pelvis provided there is an anatomy suitable for effective intracavitary Ra therapy. (BBB)

47600 THOROTRAST-INDUCED HEMANGIOENDOTHELIOMA OF LIVER. (A CASE WITH THIRTY-YEAR LATENT PERIOD). Kahn, Daniel (Meriden Hospital, Conn.). Conn. Med., 31: 557-60(Aug. 1967).

A case of fatal hemangioendothelioma of the liver attributed to Thorotrast injection was reported. The patient, a 55-year-old man, received in 1933 an injection of 25 ml of Thorotrast intravenously over a 3-min period, to exclude a suspected liver abscess. The liver and spleen were outlined by the Thorotrast and appeared normal. A stepwise increase in alkaline phosphatase over the last four yr of his life was the only indication of a slowly progressing hepatic lesion. Other liver function tests were normal until the terminal illness, characterized by intraabdominal hemorrhage, hepatic enlargement and decompensation, and profound anemia with shock. Autopsy findings revealed a huge hematoma which involved the lower half of the anterior abdominal wall and extended around the umbilicus and into the anterior surface of the scrotum. The spleen was surrounded by firm fibrous adhesions, and a nodule was found in the adhesions between the omentum and anterior liver surface. Histologically the hepatic tumor consisted of newly formed capillaries as well as systems of newly formed endothelial-lined spaces. There was central necrosis of the nodules. Foreign matter, partly iron and partly remnants of ThO_2, was seen both in liver cells and Kupffer cells. They were within mononuclear elements and free in the interstitium of the newly formed vascular tumor. The similarity of the pathology to those of other clinical cases and induced tumors adds to the probability that liver hemangioendothelioma is the most common neoplastic lesion induced by Thorotrast. Emphasis was placed on the danger of Thorotrast as a diagnostic medium in medical practice. (BBB)

47601 CLINICAL SIGNIFICANCE OF RADIOTHERAPEUTIC SEQUELAE. Fischer, A. W. (D.R.K. Anschar-Krankenhaus, Kiel). Aesthet. Med., 15: 2-3(Jan. 20, 1966). (In German).

Many tissue destructive sequelae may appear after irradiation. Necrosis of the soles of the feet and surfaces of the hands after irradiation treatment for hyperhidrosis, amyloidal brain cyst formation after irradiation of carcinoma of the skin of the head, destruction of clavicula and ribs, with edema of the arm following postoperative irradiation of a mammary carcinoma site, and various types of necrotic sequelae following irradiation for renalectomy, syringomyelia, pruritis ani, and gynecological carcinoma have been observed. When tissues damaged by irradiation were removed surgically, it was frequently difficult to ascertain the boundaries between the injured and healthy tissue. Necroses arose at the borders of the surgical wound. Too early removal of stitches was followed by retraction of the blood vessels and serious hemorrhages. Surgical repairs of irradiation injured tissues had their limits. Extensive ulcerations of the arm with exposure of the blood vessels required amputation of the arm. After injury of the rectum and sigmoid by gynecological irradiation the damaged tissue was resected, but here even the best suture technique failed. Stenosis or severe hemorrhages required construction of an anus praeter. Even without stenosis, extensive scarification and fistula formation might take place. Plastic surgery to repair irradiation injuries frequently taxed the patience and endurance of the patient, and the skill of the surgeon. In cases where after irradiation an area was suspected of developing a carcinoma, it was best to remove the entire area completely and undertake plastic repair, instead of making a test excision that might not heal. (BBB)

47602 CARCINOMA OF THE VAGINA FOLLOWING TREATMENT OF CARCINOMA OF CERVIX WITH RADIATION THERAPY. Edwards, Manis C. (Univ. of Arkansas, Little Rock). J. Arkansas Med. Soc., 64: 46-9(June 1967).

The carcinogenic effect of radiation as a possible etiologic factor in late vaginal occurrence of carcinoma of the cervix treated radiologically was evaluated. Tumor clinic records at the University of Arkansas Medical Center were reviewed for carcinoma of the vagina occurring five or more years following treatment of carcinoma of the cervix with radiation therapy. Records of patients treated surgically for in situ and Stage 1 lesions during the same period of time were reviewed for comparison. Three of 403 patients irradiated for Stage I-II carcinoma of the cervix developed invasive epidermoid carcinoma of the vagina five or more years posttherapy, an incidence of 0.7%. One of 77 patients treated surgically for Stage 0-I carcinoma cervix developed vaginal carcinoma five or more years posttherapy, an incidence of 1.3%. Thus, late vaginal carcinoma, was found to occur only rarely after radiological treatment of cervical carcinoma. Because of the small numbers in the study, no conclusions could be drawn as to whether this form of treatment was an important etiologic factor. (BBB)

47603 FUNCTIONAL AND STRUCTURAL ALTERATIONS FOLLOWING X IRRADIATION OF THE CEREBRAL CORTEX IN THE MONKEY. Caveness, W. F.; Carsten, A.; Schade, J. P. (National Inst. of Neurological Diseases and Blindness, Bethesda, Md.). Excerpta Med. Int. Congr. Ser., No. 100, 784-7(1966). (BNL-10943).

The right half of the cerebral cortex of 17 year-old monkeys was x-irradiated at a total dose of 3500 R. Animals were sacrificed at intervals from 3 days to 47 weeks, and tissue studies were made. Functional measurements were made by EEG and cine recordings. Beginning at 18 weeks postirradiation, EEG alterations occurred including seizures and paresis. Dendritic plexus measurements showed marked reduction with time after irradiation. Other histological findings included mononuclear cells, glial proliferation, pyknotic pyramidal cells, necrosis, glial reactions, myelin degeneration, inflammatory reaction, vascular changes, and calcification. (C.O.)

47604 PRELIMINARY HISTOPATHOLOGICAL OBSERVATION OF Q-SWITCHED RUBY LASER RADIATION ON DERMAL TATTOO PIGMENT IN MAN. Laub, Donald R.; Yules, Richard B.; Arras, Milton; Murray, Donald E.; Crowley, Lawrence; Chase, Robert A. (Stanford Univ., Palo Alto, Calif.). J. Surg. Res., 8: 220-4(May 1968).

A Q-switched (10- to 20-msec pulse duration) ruby (6943 Å) laser was applied with energy density varying from 2 to 7.3 J/cm^2 to human skin, with the beam focused by a long focal length lens. After treatment of black tattoo with 2 to 4.4 J, almost complete

blanching of the pigment was observed clinically. Biopsies at the seventh and twelfth day post-treatment showed marked depigmentation microscopically. There was no evidence of thermal or radiation injury. The epidermis remained intact without nuclear change, bullae, or necrosis. Likewise, the dermis was free of degenerative changes of the appendages, inflammation, or vascular injury. Areas treated with higher doses were obviously damaged (5.6 to 7.3 J/cm^2). A subepidermal bulla was present in which fringes of degenerated cytoplasmic processes protruded from the lower end of the detached basal cells into the bulla cavity, a characteristic of second-degree burn. A mild acute vasculitis was noted in the dermis. In addition, there was hydropic swelling of the epidermal nuclei, vacuolization of basal cell cytoplasm, and some areas of epidermal coagulation necrosis. This latter change was consistent with third-degree burning. The other nuclear changes were consistent with first-degree burning. Biopsies taken three months later from an area receiving the highest dose showed moderate to marked epidermal thinning and moderate dermal collagenization. (BBB)

47605 UROLOGICAL COMPLICATIONS FOLLOWING THE TREATMENT OF CARCINOMA OF THE UTERINE CERVIX, WITH SPECIAL REFERENCE TO THE USE OF ILEUM IN THE TREATMENT OF THESE COMPLICATIONS. Moonen, W. A.; Breedveld, H. W. (Groot-Ziekengasthuis, Hertogenbosch, Netherlands). Arch. Chir. Neer., 19: 91-107(1967).

Injury to the ureters during radiotherapy of cervical carcinoma and surgical repair of this injury using the ileum are reported. In the course of radiation treatment the distal ureters are in the danger zone. If in Stage II cases the parametria are infiltrated, the danger to the ureters during treatment is even greater. Ureterovaginal fistula may occur in patients who have been given radiological treatment exclusively. Irradiation may have a late effect on the ureters so that the kidneys which several months after the irradiation still show a normal outline may yet become hydronephrotic. This was seen to happen as late as 3 yr after treatment. These late hydronephroses reach a peak after 27 months on an average. The diagnosis of ureteral fistula and stenosis is discussed. Often in the treatment of this condition, simple reimplantation of the ureters into the bladder and even a Boari operation are impossible. In some cases interposition of ileum between the ureter and the bladder may be desirable. The prevention and surgical treatment are discussed. Reflux from the bladder to the ureter proved to be unusual (after the substitution of ileum for the distal ureter). Ileo-cystostomy by the method of Janknegt (papilla method) is advisable in these cases. (BBB)

47606 THE BEHAVIOR OF THE HYPOPHYSIS, ADRENALS, AND THYROID GLAND DURING RADIATION SICKNESS INDUCED BY INTERNAL IRRADIATION. Tkachev, A. V.; Tkacheva, G. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 872-5(1967). (In Russian).

Acute radiation sickness was induced in male rats weighing 170 to 250 g by subcutaneous injection of a nitric acid solution of ^{210}Po at the rate of 0.1 μc/kg. The animals were investigated at various times from six hours to 14 days. It was found that the early period of ^{210}Po-induced sickness was characterized by simultaneous stimulation of the hypophysis, adrenals and thyroid gland. At the climax of radiation sickness the hyperstimulation of the adrenal cortex was combined with lowering of the thyroid function. A high functional status of the adrenal cortex was observed during the entire period of acute sickness; there were no destructive changes. In the final period, destruction and focal necrosis were observed in the pars anterior hypophyses. (JPRS)

47607 LOCAL RADIATION BURNS. A CLINICAL STUDY OF 198 BURNS WITH SPECIAL REFERENCE TO TREATMENT BY PLASTIC SURGERY. Rintala, Aarne (Finnish Red Cross Hospital for Plastic Surgery, Helsinki). Acta Chir. Scand., Suppl., 376: 118p.(1967).

Plastic surgical treatment of a large number of radioinduced skin injuries is reported. The therapeutic results of 156 nonmalignant radiation injuries treated by plastic surgery were considered good in 112 cases (72%), satisfactory in 32 (20%), and poor in 12 (8%). During the period of treatment three patients died of secondary complications and later one patient of late sequelae of the radiation injury. Of 39 tumors in 31 radiation cancer patients treated by plastic surgery, 7 led to death. Of these, six were attributed to radiation cancer and one to complications of the radiation injury while the remainder of the patients recovered. All recurrences occurred before the end of a year and the deaths occurred within two years from termination of treatment. The therapeutic result of 36 malignant radiation burns was good in 20 cases, satisfactory in 5, and poor in 11. The late result was with regard to appearance and function, slightly more favorable than the primary result but equal with regard to symptoms. The end results were slightly more favorable in the younger age groups than in the older ones. No distinct difference could be demonstrated between sexes. The late result was distinctly better in nonulcerating than in ulcerating radiation skin injuries and was also better in the complication-free injuries than in the complicated ones. No obvious difference in the results was noted with respect to the reconstructive methods. The importance of early surgical repair in the treatment of both nonmalignant injuries and radioinduced cancer is emphasized. (BBB)

47608 EVALUATION OF FATIGUE AND MENTAL ALERTNESS OF PERSONS WORKING DURING EXPOSURE TO SMALL DOSES OF IONIZING RADIATION. Losev, A. A. Gig. Tr. Prof. Zabol., No. 8, 50-2(1967). (In Russian).

Three groups of atomic research workers, 23 to 40 yr of age (94% male and 6% female), were tested to determine the effects of small doses of ionizing irradiation on mental alertness. The first group consisted of 116 persons exposed to less than a 15-ber dose over a 5 to 8 yr period, the second group consisted of persons exposed to 15 to 50 ber doses over the same period, and the third group (control) consisted of 101 persons with no irradiation exposure. The test given for mental alertness is a standard test having a text of 265 words. The subject is asked to cross out two letters (in this case K and R) whenever they occur in the text, and the time allowed is 10 min. The test is quickly corrected with the use of a key placed over it. Speed and accuracy serve as indices. The number of errors generally increases at the end of the text or is evenly distributed with increase of fatigue. An uneven distribution of errors, with phases of correct work alternating with incorrect work, indicates a periodic state of protective inhibition. This state is characteristic of the initial stage of central nervous disease of the vascular and neurotic type. Findings show that there are no significant differences between the experimental and control groups in the number of errors made. Functional deviations of the nervous system in the form of various poorly expressed neurotic states were found in 60 persons of the experimental groups and in 15 persons of the control group. These persons made many errors indicating increased fatigue; however, the number of errors was approximately the same for persons of the experimental and control groups. It is concluded that small doses of ionizing irradiation do not affect mental alertness. (ATD)

47609 PROBLEM OF NEURORADIOEMBRYOLOGICAL EFFECT. Piontkovskii, I. A. (Inst. of Higher Nervous Activity, Moscow). Radiobiologiya, 7: 781-9(1967). (In Russian).

A survey of the literature (52 references, 1920 to 1967) on the effect of irradiation of pregnant women for therapeutic or diagnostic purposes on the central nervous system of the embryo or fetus (neuroradioembryological effect NREE) is presented. Intrauterine manifestations of NREE were studied mainly but inadequately from morphological aspects, considerably less from the genetic, biochemical, and physiological. Postnatal manifestations of NREE can be quite varied and appear primarily as macroscopically visible congenital disorders of the brain structure, but often there are anomalies of brain development that are revealed only by detailed investigations of behavior, conditioned-reflex activity, and electrophysiological indicators. Apparently even very small doses (a single dose of 1 R) can cause NREE in certain forms. NREE is a slowly-proceeding degenerative process not compensated in postnatal life, an organic disorder of the CNS with a varied phenomenology. (JPRS)

47610 INVESTIGATION OF THE NONTHERMAL EFFECT OF MICROWAVES ON THE CARDIAC RHYTHM OF FROGS. Levitina, N. A. Byull. Eksp. Biol. Med., 62: No. 12, 64-66 (Dec. 1966). (In Russian).

The extracardiac and spontaneous effects of microwaves on the cardiac rhythm of the frog were studied. Five experiments were conducted. One series was designed to study the effects on intact frogs. Here, one group of frogs was irradiated on the spine while the other was irradiated on the dorsal surface of the head. Another series was designed to clarify the role of individual components of the reflex arc in the mechanism of microwave effects on the heart. These were conducted in three groups: spinal irradiation of anesthetized frogs; spinal irradiation of frogs with denervated hearts; and irradiation of the denervated heart in situ. Cardiac rhythm was recorded using needle electrodes hooked up to an Alvar electrocardiograph. A LMS-253-A microwave generator (λ = 12.5 cm) created a nonpulsed field of 0.03 to 0.06 mw/cm^2 that did not have a demonstrable thermal effect. The species Rana temporaria weighing 30 to 40 g was used. Irradiation commenced 10 to 15 min after stabilization of cardiac rhythm and lasted for 20 min (spine and head) or 15 min (heart). Cardiac rhythm was recorded for 20 min before and 10 to 15 min after irradiation. In the spinal irradiation series (intact frogs), the following changes (±6% of normal) in cardiac rhythm were noted: retardation–50%; acceleration–20%; two-phase shift–10%; no change–20%. In the series where the heads of intact frogs were irradiated dorsally,

no retardation of cardiac rhythm was noted. An acceleration (9% higher on the average) of rhythm was noted in 80% of the cases. There was no change in the remaining 20%. Spinal irradiation of anesthetized frogs produced no changes in cardiac rhythm. The same was true of spinally irradiated frogs with denervated hearts, and of frogs whose denervated hearts were irradiated in situ. Results indicated that spinal irradiation had a negative chronotropic effect on cardiac rhythm while dorsocranial irradiation had a positive one. This is similar to results obtained earlier in experiments with rabbits. The results of these experiments indicate that inhibition of the central nervous system, disruption of extracardiac innervation, or irradiation of the denervated heart in situ preclude a chronotropic effect. These data would tend to confirm the reflex nature of the chronotropic effects of microwaves. (TSS) (ATD)

47611 CHANGE OF THE CALCIUM CONTENT IN THE TISSUES OF RABBITS UNDER THE EFFECT OF IONIZING RADIATION AND SUBSTANCES INFLUENCING OXIDATIVE PHOSPHORYLATION. Grozdov, S. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 23-9(1968). (In Russian).

Sixty-three male rabbits weighing 2.5 to 3 kg were used. Calcium, potassium, and sodium were investigated in the blood serum, and tissue hydrolysates of intact animals and animals subjected to the following effects: total γ-irradiation at a dose of 800 R by a cobalt source at a dose rate of 190 R/minute (studied 24 hrs and 8 days after irradiation), subcutaneous injection of ^{210}Po at a dose of 0.1 μCi/kg (studied 16 days later), and intravenous administration of 6 ml of 0.4% solution of 2,4-dinitrophenol, 4 ml of 2.5% solution of sodium oleinate and 1.2 ml of 0.25% solution of adenosine triphosphate (ATP) (studied after 15, 8, and 7 min, respectively). A considerable increase of calcium in the tissues followed the administration of ^{210}Po; increases were also caused by 2,4-dinitrophenol and sodium oleinate. The administration of ATP at the same dose and 1 ml of 5% $MgCl_2$ solution before and after the same radiation and pharmacological effects reduced the calium concentration in the blood plasma. That effect was eliminated by irradiation and disturbers of oxidative phosphorylation. The calcium accumulation in the tissues evidently had an important role in the disturbance of oxidation and phosphorylation under the effect of radiation and disturbers of them. (JPRS)

47612 COMBINED RADIOTHERAPY AND SURGERY FOR INFILTRATING CARCINOMA OF THE BLADDER. Deweerd, James H.; Colby, Malcolm Y. Jr. (Mayo Clinic, Rochester, Minn.). Trans. Amer. Ass. Genito-Urinary Surg., 59: 179-85 (1967).

Complications of bladder irradiation in a 52-patient series were reported. In the first group (33 patients) a tumor dose of 4800 RAD was given in two 12-day courses, with a three-week interval, by 6-MeV x rays. In the second group, doses of 1800 to 2400 RAD were given over a three day period. Patients treated within the group one protocol experienced symptoms of bowel and rectal irritation. Frequency, urgency, and dysuria then largely disappeared except in 12 patients who had extensive malignant involvement of the vesical wall or chronic infection. Signs and symptoms of protocolitis also disappeared in most patients. Four patients continued to experience bowel irritability for months after treatment. The short, extensive course of irradiation given to group two patients uniformly produced mild to moderately severe diarrhea, but this was a transient, controllable problem. However, three patients had severe, intractable diarrhea. One with conduit urinary diversion required diversion of the fecal stream by transverse colostomy four months after cystectomy. The second patient, treated by ureterosigmoidostomy, required sigmoid colostomy and conduit diversion ten months later. The third patient, experiencing progressive diarrhea, died of peritonitis from a ruptured pelvic abscess one and a half months after cystectomy. Two others had continued but controllable hypermotility of the bowel. The late complications included two cases of prolonged urethral drainage and one each of bowel obstruction, stomal hyperkeratosis, parastomal herniation, factitial proctitis and stenosis with lymphedema, and factitial proctitis with perianal ulceration. (BBB)

47613 EXTRACTION OF TEETH AFTER CANCERICIDAL DOSES OF RADIOTHERAPY TO THE HEAD AND NECK. Solomon, Harold; Marchetta, Frank C.; Wilson, Robert O.; Miller, Richard A.; Detolla, Harold W. (Roswell Park Memorial Inst., Buffalo). Amer. J. Surg., 115: 349-51(Mar. 1968).

Prevention of osteoradionecrosis and dental care in patients who received radiotherapy in the oral region were reported. Tissue changes resulting from cancericidal doses of radiotherapy were described. An open tooth alveolus after extraction could provide a portal of entry for bacteria, and lead to osteoradionecrosis. The controversy as to whether it was safe to extract teeth once the patient had received radiotherapy was considered. The authors followed a policy of full mouth extractions prior to head and neck irradiation, but many patients for various reasons were treated with teeth in place. In 31 patients previously treated with radiation, symptoms of a dental nature developed requiring extraction. Alveolar abscesses developed in some; others had pain and tenderness secondary to caries and infection. All patients were hospitalized and placed on a preoperative regimen of oral irrigations and systemic antibiotic therapy. Surgery was performed by accepted aseptic techniques and with minimal trauma. Bone spicules were rongeured and the mucoperiosteum was sutured to close the wound. Postoperative antibiotics and warm saline mouth rinses were continued. Soft diets were used. Osteoradionecrosis of the mandible did not develop in any of the patients. These results indicated that teeth could be extracted with considerable safety in patients who had received cancericidal doses of radiation to the head and neck areas. (BBB)

47614 RADIODERMATITIS. STUDY OF 60 CASES OF THE AUTHORS. Montfort, J.; Duperrat, B. (Hopital Saint-Louis, Paris). Sem. Hop. Paris., 41: 465-72(Feb. 14, 1965). (In French).

Of 72 cases of radiodermatitis studied, 12 cases were occupational (hospital radiologists) and 60 cases concerned other patients. A study was made of these 60 cases, 39 women and 21 men, to determine the etiology and histopathology of the radiodermatitis. The obstacles of tracing the etiologic factors were: lack of information or recollection of patients as to type, amount, and frequency of treatment and length of time elapsed between irradiation and appearance of dermatitis. One patient with epigastric angioma had received 2000 R, in four applications of 500 R each, over a six month period. Another patient with anterior thoracic Paget-type epithelioma had received 1000 R. A third had received 3500 R in several doses and a lesion had developed on the right index finger. Seven patients had received radiation by the Chaoul method and four by Ra implantations. The greater number of women patients led to the conclusion that women are more radiosensitive. In age, the greatest average frequency of radiodermatitis was from 30 to 70 yr for all patients and after 50 yr in women patients. The latent period ranged from 24 hr to 40 yr, the average being about eight yr for women and one yr for men. Radioinduced cancer occurred in only six cases, or 10%; four women over 60 yr of age and two men aged 44 yr. Surgical removal and repair of the severely affected areas was recommended in view of the latent carcinogenic feature of radiodermatitis. (BBB)

47615 ACTION OF THOROTRAST ON THE BONE MARROW. Stecher, G.; Kubanek, B.; Zahnert, R.; Fliedner, T. M.; Burckhardt, K. (EURATOM, Freiburg i. B.). Blut, 16: 328-32(Mar. 1968). (In German).

The state of erythropoiesis was evaluated in 12 patients, aged 40 to 60 yr, who received intravenous injections of Thorotrast (ThO_2) about 20 yr previously. Complete blood counts, bone marrow aspirations, and autoradiographs of bone marrow smears were performed. Peripheral blood cell counts were within normal limits in all subjects; however, marrow smears of ten persons showed increased erythropoiesis. Furthermore, an increase of binucleated red cell precursors, that normally are rarely found, was noted. Thorotrast deposits were present in all marrow smears, and autoradiographs demonstrated many α tracks radiating from the incorporated radioactive material. The question was discussed of whether the cytologic abnormalities in the erythroblasts are due to the effect of continuous exposure to low levels of ionizing radiation. (BBB)

47616 ADENINE UPTAKE BY RAT THYMOCYTES X-IRRADATED IN VITRO. Christensen, Gerald M.; Jackson, Kenneth L. (Univ. of Washington, Seattle). Radiat. Res., 35: 410-20(1968).

The effect of in vitro x-irradiation of thymocytes on the uptake and incorporation of adenine-8-^{14}C was studied as a function of time, dose, external phosphate concentration, and pH. Uptake of labeled substrate was depressed when measured 1 hour or more following exposure, and the extent of depression was dose-related between 0 and 200 R, with little further effect between 200 and 1000 R. Comparison of the rate of development of radiation injury measured by adenine incorporation with the rate of cell death determined by uptake of erythrosin B showed that depression in adenine incorporation preceded cell death by 3 to 4 hours. Radioinduced alteration in adenine incorporation was insensitive to external phosphate concentration, and the inorganic phosphorus content of the cells decreased following exposure, in contradiction to the mechanism proposed for thymocyte injury measured by DNA release and nuclear homogenization. Incorporation of adenine-8-^{14}C by the unirradiated thymocyte was highly pH-dependent, but this pH dependence was lost in the irradiated cell even though significant amounts of substrate were incorporated. It was concluded that radiation damage, measured by depression of adenine uptake, was not dependent on phosphate accumulation but did in-

volve a metabolic system whose activity was reflected in adenine uptake and incorporation into nucleic acids. (auth)

47617 BEHAVIOR OF THE PRINCIPAL COMPONENTS OF THE BONE MARROW OF MICE AND RATS AFTER LOCAL IRRADIATION. Kabakov, E. N.; Fofanova, K. A.; Perestoronina, N. N. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 46-51(1968). (In Russian).

The right rear extremities of male SVA mice 7 to 12 weeks old weighing 18 to 20 g and male Wistar rats weighing 180 to 200 g were irradiated at 214 R/min for 10 minutes. Five mice and five rats were killed each day for 10 days and their irradiated and shielded extremities examined. It was found that postirradiation regeneration of the bone marrow occurred with a predominance of activity of the erythropoietic part. The regeneration may be called erythroid, with a high rate of accumulation of normoblasts (doubling in about 8 hours), a considerably higher than normal level of those cells in the marrow, a high maturation index in the erythroid population and inadequate mitotic activity. The hypothesis was expressed that a transformation of lymphocytes into erythroid cells occurred and that it became cyclic under the effect of radiation damage. (JPRS)

47618 HYPOPARATHYROIDISM FOLLOWING ^{131}I THERAPY FOR HYPERTHYROIDISM. Eipe, Joseph; Johnson, Sarah A.; Kiamko, Rosario T.; Bronsky, David (Cook County Hospital, Chicago). Arch. Intern. Med., 121: 270-2(Mar. 1968).

An unusual complication of radioiodine therapy is reported in a patient who developed hypoparathyroidism following the administration of ^{131}I for treatment of hyperthyroidism. The 58-yr-old man developed hypoparathyroidism five months after receiving 15.7 mCi of sodium iodide-^{131}I administered in divided doses over 11 months. Only three such cases were reported previously. Exposure of the parathyroid glands to radiation from ^{131}I should be very limited under normal circumstances. The β particles emitted by ^{131}I penetrate and destroy tissue to a depth of about 2 mm. The parathyroids ordinarily lie outside and next to the capsule of the thyroid gland so that only one surface is exposed to radiation. Under exceptional circumstances, however, the parathyroid glands may be fewer than four in number and may be located within the thyroid gland. In this uncommon situation, the parathyroids could be irradiated from all sides and destroyed. (BBB)

47619 MULTIPLE FACTORS ALTERING RADIATION SENSITIVITY. Nutr. Rev., 24: 313-15(1966).

Survival studies of three strains of x-irradiated germfree and conventionally maintained mice are reviewed that indicated separate involvement of bacterial contamination and genetic factors in the determination of radiation sensitivity. Normally bred ICR and CF1 and inbred RFM mice were used. At 10 to 12 weeks of age the germfree and conventional mice were irradiated with 500 to 1000 R of x irradiation at an exposure rate of about 100 R/min. The 30-day mortality following these radiation doses ranged from less than 10 to 100%. In all cases the germfree animals survived irradiation better than did conventional animals of the same strain and sex. However, there were also significant differences between strains. With germfree animals, resistance to irradiation was greatest with ICR, followed by RFM, and then CF1, whereas conventional CF1 mice survived better than RFM mice. The amount of radiation protection afforded by germfree conditions was least with CF1 animals. Chemically defined liquid diet supplemented groups experienced lower mortality after x irradiation than did unsupplemented controls. These mice also lost less weight during the postirradiation period. In an attempt to isolate the nutrient responsible for the decreased radiation sensitivity, amino acids, fatty acids, vitamins, carbohydrates, and salts were fed separately in distilled water in the amount in which they occurred in the complete supplement. No single class of nutrients produced the protective effect that was seen with the complete supplement, indicating that either the complete supplement or nutrients from more than one class were necessary for resistance. This difference in response to dietary supplementation could be due in part to nutrient contributions from the intestinal microorganisms. (BBB)

47620 PROTON-BEAM THERAPY IN ACROMEGALY. Kjellberg, Raymond N.; Shintani, Akira; Frantz, Andrew G.; Kliman, Bernard (Massachusetts General Hospital, Boston). New Engl. J. Med., 278: 689-95(Mar. 28, 1968).

The excess of human growth hormone (HGH) in acromegalic patients was effectively reduced by irradiation with the Bragg peak of the proton beam. Production of radionecrosis in a major portion of the pituitary adenoma reduced the circulating HGH and returned the clinical and laboratory status of the patient toward normal. Advantages of proton and other heavy particle (sharp collimation of beam edges and the increased amount of radiation at the end of the beam range) were discussed. Bragg-peak proton hypophysectomy was used in 22 acromegalic patients. Of 14 followed for two to 36 months, size of hands, feet, or face decreased in nine. Variable improvement took place in headache, fatigability, heat intolerance, joint pain, sexual function, weight, skin, tachycardia, hypertension, visual fields, glucose tolerance, thyroid-function tests, and ketosteroid and hydroxysteroid secretions. Levels of HGH fell strikingly in eight. The complications of proton-beam therapy included transient diplopia, headache, and one case of anterior pituitary insufficiency. Three patients reported intermittent, mild diplopia. In over 150 diabetic patients treated by proton-beam hypophysectomy, postoperative diplopia was frequent but always temporary. The oculomotor nerves, only a few millimeters lateral to the pituitary gland, may receive as much as 4000 RAD of radiation as the proton beams converge on the sella, but the nerves recover from this radiation effect. The first patient became blind in the left eye so that in subsequent patients irradiation was confined below the clinoid processes, and a major revision in the geometry of the isodose curves reduced irradiation along the beam paths. (BBB)

47621 EMPLOYMENT OF AN INDICATOR SYSTEM BY SIMMONS' METHOD IN STEFFEN'S TEST WITH TISSUES OF IRRADIATED AND INTACT ANIMALS. Ulanova, A. M.; Zueva, V. A. Zh. Mikrobiol., Epidemiol. Immunobiol., No. 10, 106-9 (Oct. 1967). (In Russian).

The possibility of using normal human erythrocytes, treated by Simmons' method, as an indicator system in Steffen's antiglobulin test was studied. The method was simple and reproducible in conditions of any laboratory. The results produced were stable. Erythrocytes may be sensitized both with the purified gamma-globulin and by contact of treated erythrocytes with the normal serum of the given species of animals. An indicator system after Simmons was used in determining the presence of incomplete antibodies in the tissues of irradiated and intact animals by Steffen's method. The results demonstrated that tissues of experimental irradiated animals exhausted the antiglobulin serum more than the emulsion of intact animal organs. Thus, investigations showed a possibility of using Simmons' method in Steffen's test. (auth)

47622 CONCERNING TWO CASES OF IDIOPATHIC THROMBOCYTOPENIC PURPURA, TREATED WITH MICRODOSES OF ^{32}P FOLLOWING FAILURE OF CLASSICAL THERAPY. TRANSIENT THROMBOCYTOGENIC EFFECT OF WEAK DOSES OF RADIOACTIVITY. Croizat, P.; Revol, L.; Berger, J.; Bothier, F.; Chataing, B.; Byron, P. (Institut Pasteur, Lyon). Hemostase, 6: 129-38(1966). (In French).

Effect of internal radioisotope irradiation on platelet levels was studied in two cases of idiopathic thrombocytopenic purpura that were observed over a three to four yr period. Various other methods of treatment, including corticosteroid therapy and splenectomy, were tried without success, before ^{32}P was used. The first patient received ^{32}P after uterine hemorrhage and a very low platelet count (18,000/mm^3). Doses administered over a three week period were 20, 10, 10, and 10 μCi. At the end of that time bleeding had stopped and the platelet level had increased to 40,000 and two weeks later to 164,000. Two months later, the count was normal (200,000). The second patient had received corticosteroid therapy for bleeding but the platelet count had fallen as low as 10,000. After one treatment (10 μCi), platelets increased to near the normal range (100,000 to 180,000). Steroid therapy was then continued. It was concluded that in both cases the use of ^{32}P was important in effecting an improvement, especially in the increase in platelets. (BBB)

47623 DEPENDENCE OF RADIATION-THERAPEUTIC RESULTS ON TRANSIENT DOSE DISTRIBUTIONS. A STATISTICAL STUDY. Knauer, Luitpold (Univ., Munich). Strahlentherapie, 135: 656-65(June 1968). (In German).

One hundred and fifty cases of a radiotherapy clinic were reviewed to examine whether deviation from the standard therapy plan had any influence on the results. The relation between cures and recurrences in the two years following therapy seemed not to be determined by either the total dose or the overall irradiation time alone. There was, however, a significant relation between the result and the so-called cumulative dose (D_{kum}) derived from the Strandqvist function. For the patients studied and for all tumor localizations better results were obtained with higher D_{kum}. A cure rate of 50% was observed only at D_{kum} larger than 2500 R. A scheme was proposed for calculating the supplementary dose in case prolongation of the standard radiation period is necessary. (auth)

47624 CONTACT DIGESTION IN RATS AFTER DIFFERENT VARIANTS OF PARTIAL BODY IRRADIATION. Domanskii, V. Yu. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Radiobiologiya, 7: 866-71(1967). (In Russian).

Male white rats weighing 150 to 200 g were kept on a constant

ration and deprived of food for 10 to 12 hours before local irradiation of the abdomen and part of the intestine with 700 R of x radiation. Contact digestion was deeply disturbed in the irradiated parts, as manifested by suppression of invertase activity on the mucosa after three days and in the homogenate three and 15 days after irradiation. It was stated that disturbances of contact digestion, of carbohydrate hydrolysis in particular, were an important component in the development of acute radiation sickness. (JPRS)

47625 INTERRELATION BETWEEN CONVULSANT DRUGS AND X RADIATION ON THE CENTRAL NERVOUS SYSTEM OF RATS. Vernadakis, A.; Timiras, P. S. (Univ. of California, Berkeley). Contract AT(11-1)-34. Arch. Int. Pharmacodyn., 170: 146-51(Nov. 1967). (UCB-34-P-82-143).

Ionizing irradiation increases the excitability of the central nervous system (CNS) in both adult and developing rats perhaps because it selectively damages inhibitory systems. The convulsant drugs strychnine and pentylenetetrazol were used in this study to determine whether x radiation differentially affects excitatory or inhibitory systems. Their convulsant effects were determined in 4-, 8-, 13-, 36-, and 72-day-old rats, and in other rats exposed to a single dose of 500 R x radiation at 2 days after birth or at 59 days after birth. The convulsive dose (CD_{50}) of strychnine did not vary significantly in rats from 4 to 8 days old, but beginning with the 8th day, the CD_{50} continuously increased with age. The CD_{50} of pentylenetetrazol increased up to the 13th day and leveled off thereafter. Changes in the CD_{50} of strychnine with age were thought to be due both to the development of inhibitory systems and a blood-CNS barrier to strychnine. The data suggest that there is no blood-CNS barrier to pentylenetetrazol. In rats x irradiated at 2 days of age, the CD_{50} of strychnine significantly decreased at 13 days of age as compared to that of controls of the same age, whereas the CD_{50} of pentylenetetrazol was the same as that in controls. In rats x irradiated at 59 days, the CD_{50} of strychnine was not significantly different at the 72nd day whereas the CD_{50} of pentylenetetrazol was significantly higher. The decreased CD_{50} of strychnine in irradiated rats suggested that neonatal irradiation depresses primarily the development of inhibitory systems. The increased CD_{50} of pentylenetetrazol in adult irradiated rats suggested that irradiation impairs excitatory systems concerned with the spread of seizure. (BBB)

47626 PHYSICIAN AND RADIODIAGNOSIS. Demulder, R. (Manufacture Belge de Lampes et de Materiel Electronique, Brussels). Acta Tuberc. Pneumol. Belg., 57: 237-62(July-Aug. 1966). (In French).

A description of radiation dose terminology and of categories of personnel exposed to radiation was given as an introduction. The legal obligation of radiation installations and of the individual radiologists was outlined. Dose values for each personnel classification were established according to their exposure. How physical and medical controls were regulated by the Ministry of Public Health in Belgium was explained. The radiobiologic effects of x rays were traced through biochemical processes in terms of indirect and direct effects and the stages of cellular and tissue alteration. Radiation pathology was described in terms of the different types of reactions. The technique of radiodiagnosis, radiography, radiophotography, and fluoroscopy were explained. It was concluded that radiation hazards were largely eliminated for personnel and patient if radiologists ensured that optimal methods of radiodiagnosis were used. (BBB)

47627 FORMATION OF FORMYL DERIVATIVES OF FOLIC ACID IN THE HYALOPLASM OF PIGEON LIVER AFTER IRRADIATION AND ADMINISTRATION OF PROTECTOR. Romantsev, E. F.; Khalikov, S. K. (Inst. of Biophysics, Moscow). Radiobiologiya, 8: 107-10(1968). (In Russian).

Pigeons were irradiated with the absolutely minimum lethal dose of γ rays, 3000 R in 19 min 2 sec. The formation of formyl derivatives of folic acid in liver extract was inhibited in 10 to 60 min and was normalized in 24 hr. The injection of β-mercaptopropylamine (200 mg/kg), a dose with a strongly expressed radioprotective action, caused a sharp suppression of the synthesis of the formyl derivatives of folic acid in 10 min after injection. (JPRS)

47628 EFFECTS OF WEIGHTLESSNESS OF RADIATION-INDUCED SOMATIC DAMAGE IN DROSOPHILA LARVAE. Oster, Irwin I. (Bowling Green State Univ., Ohio). BioScience, 18: 576-82(June 1968).

Drosophila melanogaster larvae were exposed to similar doses of radiation in Biosatellite II and on earth to study the effects of weightlessness on somatic cell injury. There was a slightly higher mortality among the young larvae exposed to radiation while in orbit than in those irradiated on earth. Earth-based experiments, prior to flight, involving acceleration, shock, and vibration yielded results essentially similar to the nonirradiated flight material and the concurrently run unirradiated groups on earth. The preflight irradiations on earth caused a slightly lower survival than the present experiments at earth level because of the lower total dose experienced by the latter (~800 R rather than 1100 to 1200 R). The more mature larvae exposed to radiation tended to be unaffected by irradiation alone. Material flown and irradiated showed a statistically significant increase in chromosome damage over the corresponding controls maintained on earth. The material flown but not irradiated was not significantly different from the material held on earth and not irradiated. The flight and the flight plus radiation groups revealed evidence of failures of proper chromosome separation (chromosome disjunction). Some cells exhibited missing or extra chromosomes that would result from such nondisjunction. It was concluded that the radiation interacted with weightlessness to induce more premature aging (early death characterized by delayed onset) and chromosome damage in actively growing and metabolizing individuals than in those irradiated at earth level. (BBB)

47629 SUPER-HIGH FREQUENCY ELECTRIC FIELD AND CRUSTACEAN GANGLIONIC DISCHARGES. Yamaura, Itsuo (Hokkaido Univ., Sapporo); Chichibu, Shiko. Tohoku J. Exp. Med., 93: 249-59(Nov. 1967).

The effect of microwave radiation (at a frequency of 11 Gcps) on isolated invertebrate ganglia was studied. In crayfish and prawn abdominal ganglia the effect was detected by analysis of changes in spontaneous impulse frequencies. The available power of 100 $\mu W/mm^3$ produced suppressed and supernormal phases in impulse frequencies. Provided that the suppressed phase was brought about by a specific action of microwave irradiation, the time constant of the declining limb in the suppressed phase exhibited a linear relation to the intensity of microwave radiation. Possible mechanisms of these two phases were discussed with relation to thermal and nonthermal actions of microwave irradiation. According to the current concept of the unit membrane, it is likely that there are polar molecules in the membrane, and especially chain-forming lipid molecules forming a layer. In the normal state, this structure permits Na influx and generates action potentials. If it is assumed that the irradiation affects only the plasma membrane, and no influence is exerted on synapses, the suppressed phase is interpreted as a lowered ability of Na influx across the plasma membrane. A high-frequency electric field may produce re-orientation of polar or charged molecules in the membrane, and as a result the Na conductance cannot decrease. The suppressed and supernormal phases correspond to the re-orientation process and the return to the original structure of the membrane. The supernormal phase is the result of a temporary decrease of Na conductance occurring as a rebound phenomenon. (BBB)

47630 A STUDY OF RADIATION DAMAGE IN CULTURED HUMAN CELLS (HELA) UTILIZING CELL SURVIVAL, CYTOGENETIC, AND FLUORESCENCE ANALYSIS. Bushong, Stewart Carlyle. Pittsburgh, Univ. of Pittsburgh, 1967. 192p.

Thesis.

Cell survival, cytogenetic analysis and fluorescence analysis were used as criteria to measure radiobiological damage in HeLa cells irradiated aerobically and anaerobically with 280 kVp x rays. Attempts were made to correlate the dose-response relations obtained using these techniques. The data obtained from the cell survival studies were adequately described by the multi-target, single-hit dose-response model and resulted in the following relations: $N/N_0 = 1 - (1 - e^{-D/129})^{2.37}$ (aerobic) and $N/N_0 = 1 - (1 - e^{-D/231})^{5.34}$ (anaerobic). Analysis of total cytogenetic damage was based upon a visual scoring of chromosome aberrations from cells sampled during their first mitosis following irradiation. This analysis resulted in the dose-response relations: $Y = 0.53 + 0.0230\ D + < 10^{-7}\ D^2$ (aerobic) and $Y = 0.53 + 0.0127\ D + < 10^{-7}\ D^2$ (anaerobic). The results of analysis of the photometrically determined intensity and spectral distribution of fluorescence of HeLa cells stained with acridine orange showed no significant difference between irradiated and unirradiated cells. The spectral distribution of molecular DNA at a concentration of 1.0 mg/ml did not change following irradiation; however, the intensity of fluorescence of molecular DNA was shown to decrease with increasing radiation dose above 20,000 rads. Photometrically determined spectral distributions of fluorescence from HeLa cells stained with acridine orange are given for several conditions of pH, staining time and concentration. Acridine orange at a concentration of $^1/_{11,000}$ for three minutes at pH 7.2 produced maximum DNA-RNA differential fluorescence. Spectral distributions are given for enzyme treated HeLa cells and for HeLa cells following periods of ultraviolet illumination. Survival of the HeLa cells following irradiation can be related directly to chromosome damage by the relations: $N/N_0 = 1 - [1 - e^{-(Y-0.53/2.80)}]^{4.28}$ (aerobic) and $N/N_0 = 1 - [1 -$

$e^{-(Y-0.53/3.06)]^{4.26}}$ (anaerobic). A positive correlation between cell survival or cytogenetic damage and fluorescence changes following irradiation was not demonstrated. It was concluded that the chromosomes of the HeLa cell are the principal target sites involved in radiation-induced HeLa cell death and a mathematical model was described to relate these two measures of radiation damage. Fluorescence analysis, under the conditions tested, was not a sensitive measure of radiation damage in the HeLa cells at radiation doses which produced significant chromosome damage and cell death. (Disser. Abstr.)

47631 DIFFICULTY IN CLINICAL ASSESSMENT OF LYMPH NODES AFTER ENDOLYMPHATIC RADIOIODINE. Blake, J. (Westminster Hospital, London). Postgrad. Med. J., 44: 336-8 (Apr. 1968).

Changes in lymph nodes produced by a therapeutic dose of ^{131}I-labeled ultrafluid lipiodol are reported. The axillary lymph nodes became tender soon after recording the lymphangiogram but showed no obvious immediate changes in consistency. After a block dissection of the left axilla, histology of the specimen obtained showed only a lipogranulomatous reaction to the previous lymphangiogram with no evidence of malignancy. The histological changes produced by lipiodol are characterized by hypoplasia and eventual disappearance of germinal centers, the presence of oil droplets in sinuses, follicles, and germinal centers, and by sinus histiocytosis. There is an initial acute reaction with infiltration by plasma cells, and polymorphonuclear and eosinophil leucocytes, followed in a few days by a foreign-body giant-cell reaction around the droplets of contrast medium. Giant cells are also present in the lining of lymphatics outside the lymph nodes. This reaction persists unchanged for several months and eventually disappears without fibrosis. (BBB)

47632 EXPERIMENTAL STUDIES ON ROLE OF SPLEEN IN RECOVERY FROM RADIATION INJURY IN MICE. I. EFFECT OF SPLENECTOMY ON SURVIVAL OF MICE FOLLOWING X-IRRADIATION. Tanaka, Nobuo (Hiroshima Univ.). Hiroshima J. Med. Sci., 15: 309-23(Dec. 1966).

Results of other investigators on the effects of leg shielding and spleen shielding on survival of irradiated mice and rats are discussed. The role of the bone marrow and spleen in hematopoiesis of irradiated animals is emphasized. Results of the present study suggest that removal of the x-irradiated spleen allows a more rapid regeneration of the damaged hematopoietic tissue and that such regeneration is related to survival of the irradiated mice. (NSA of Japan)

47633 EFFECT OF LINEAR ENERGY TRANSFER ON TUMOR INCIDENCE AND HAIR FOLLICLE INJURY IN RAT SKIN. Burns, Fredric Jay. New York, New York Univ., 1967. 98p.

Thesis.

Twenty four square centimeters of the dorsal skin of anesthetized albino rats were given single irradiation exposures. Groups ranging from 9 to 30 rats were irradiated with doses ranging from 210 rads to 6850 rads of 37 MeV alpha particles from a cyclotron. Other groups were irradiated with doses ranging from 810 rads to 12,300 rads of 0.34-MeV electrons from a Van de Graaff accelerator. The depth-dose curve of the low LET electron beam was approximately linear with a maximum penetration of about 1.0 mm of tissue, and the depth-dose curve of the high LET alpha particle beam was modified to conform to the electron curve. After irradiation the cumulative tumor incidence was determined as a function of the post-irradiation elapsed time. The severity of the acute injury at 4 weeks was assessed, and at 80 weeks the incidence of damaged hair follicles, the hair follicle survival, and the histological characteristics of the tumors were determined and compared for both types of radiation. The major results were that the correlation between the incidence of tumors and the incidence of injured hair follicles, which was observed for low LET irradiation, continues to be valid for high LET irradiation, and that the RBE for tumor incidence is 2.9 ± 0.5 in the dose region near the optimal tumor incidence. Except for the higher efficiency of the alpha radiation, the response of the skin was similar for both types of radiation. The dependence of the tumor incidence on post-irradiation elapsed time, the association between tumor incidence and hair follicle injury, the shapes of the dose-response curves for damaged hair follicles and hair follicle survival, and the histological characteristics of the tumors were the same for both types of radiation. For both alpha and electron irradiation the cumulative tumor incidence was consistent with a power function of the post-irradiation elapsed time with the exponent increasing from about 1.5 at high doses to about 2.5 at low doses. Other RBE values were determined as follows: for acute ulceration, RBE = 3.0 ± 1.0; for hair follicle survival, RBE = 2.1 ± 0.7; for the incidence of damaged hair follicles, RBE = 2.6 ± 0.4. Within the experimental error all of these values are independent of the dose. (Disser. Abstr.)

47634 THE USE OF THE ^{59}Fe AND ^{51}Cr IN THE STUDY OF ERYTHROPOIESIS AND FERROERYTHROKINETICS IN NORMAL AND WHOLE BODY X-IRRADIATED DOGS. El-Tamami, Mohei-Eldin Youssef. Rochester, N. Y., Univ. of Rochester, 1965. 250p.

Thesis.

A quantitative measurement of erythropoiesis in terms of ferroerythrokinetic indices was carried out in normal dogs and for 8 months after exposure in whole body x-irradiated dogs, using Fe-59 tagged serum and Cr-51 tagged red cells as tracers. Characteristics of the plasma and erythrocytic phases of the Fe-59 kinetic cycle in the dog were defined. The plasma radioiron clearance curve was found to be multinomial with three distinct exponential components in addition to a terminal very slowly decaying one. The initial plasma radioiron clearance rate was found to be a function of the reciprocal of the plasma iron level in the normal dog. Plasma iron turnover was taken to represent, in a large measure, the total iron incorporating capacity of the bone marrow which in turn reflects the total marrow cellularity (total erythropoiesis). The red cell Fe-59 incorporation curve was analyzed in terms of the mean peripheral red cell emergence time which represents the mean marrow time, and maximum degree of red cell Fe-59 incorporation which represents the effective capacity of the bone marrow for production of viable red cells (effective erythropoiesis). Total erythropoiesis was found to be more variable than effective erythropoiesis, among the normal dogs studied. Quantifying hemoglobin synthesis according to the one dynamic pool system in which it is assumed that there is linear progression of iron from the plasma to marrow to erythrocytes without significant deviations or feedback gave estimates which were significantly higher than those expected on the basis of the known red cell life span in the dog and the presence of a steady state in which red cell production is equal to red cell destruction. Accordingly, the mean red cell life span determined using the Fe-59 estimated hemoglobin renewal rate was shorter than that obtained directly using Cr-51 tagging of red cells in the same dogs. Since the observed characteristics of plasma radioiron clearance indicated that the plasma iron pool is in equilibrium with other labile iron pools with which iron exchange occurs at different rates, it was concluded that quantifying hemoglobin synthesis using radioiron in the dog should consider all possible sites of iron exchange and feedback as has been previously found in man. Using Cr-51 to study red cell destruction it was possible to find evidence of hemolysis in some of the apparently normal dogs that showed noticeably higher rates of hemoglobin synthesis than the remainder of the group. Characteristic and significant changes in both the plasma and erythrocytic phase of the Fe-59 kinetic cycle and the Cr-51 red cell disappearance pattern were seen after irradiation. Impairment of the erythropoietic function after irradiation was characterized by slowing down of the initial plasma radioiron clearance slope, increase in the 24 hour post-injection plasma Fe-59 level, acceleration of the slope of the late clearance phase, increase in the plasma iron level, decrease in plasma iron turnover, slowing down of the rate of emergence of red cells from the marrow, and suppression of the degree of red cell Fe-59 incorporation. Gradual recovery of the erythropoietic function was associated with gradual return of all these indices toward normal. (Disser. Abstr.)(TSS)

47635 MATERNAL-EMBRYONIC INTERACTIONS IN THE RAT AS AFFECTED BY HORMONES AND X-IRRADIATION. Hooverman, Lois Lynn Wittbecker. Madison, Wis., Univ. of Wisconsin, 1968. 161p.

Thesis.

Ovariectomy on the third day of pregnancy and daily injections of progesterone were utilized as a means of prolonging the pre-implantation period in the rat (delayed implantation). Whole body x-irradiation was administered either one day or nine days before implantation was induced with exogenous estrogen. Fetal survival decreased with each increase in x-ray dose (200 to 500 R) in rats having a one day interval between irradiation and the induction of implantation; also, the surviving fetuses weighed significantly less than nonirradiated controls. When implantation was induced nine days after irradiation, however, fetal survival was the same as in nonirradiated controls. The body weights of fetuses with a nine day interval between irradiation and the induction of implantation were significantly greater than those of fetuses with a one day interval, although less than those of the nonirradiated controls. It is concluded that a nine day interval between x irradiation and the induction of implantation allows time for repair of irradiation damage. To determine whether the uterine endometrium was a site of x-ray injury and subsequent repair, a decidual cell reaction (DCR) was induced either one or nine days after irradiation, in rats under the same hormonal conditions as in the delayed im-

plantation experiments. All irradiated rats had a slightly reduced DCR as compared to nonirradiated rats, regardless of the day trauma was inflicted; no repair was observed when nine days intervened between irradiation and traumatization. Since the fetal mortality observed in the previous experiments was dependent upon the time between irradiation and the induction of implantation, it is concluded that damage to the uterine endometrium is not a major factor in this fetal mortality. An experiment utilizing blastocyst transplantation was conducted to determine whether fetal mortality is due to irradiation injury to the blastocysts or to the maternal organism. When 500 R of whole body x irradiation was given to either the donor or recipient rat prior to blastocyst transplantation, few fetuses survived as compared to the number surviving in unirradiated, transplanted controls. It was concluded that both direct injury to blastocysts and indirect injury through damage to the maternal organism occur. Beta-mercaptoethylamine (β-MEA), a radioprotective agent, was administered to pregnant rats before irradiation on day 5 of pregnancy, in an attempt to increase fetal survival. Neither 10 nor 20 mg β-MEA 100 gm body weight had a radioprotective effect on the unimplanted blastocysts, as measured by fetal survival to the 19th day of gestation, even though the same doses of β-MEA permitted survival of adult female rats following a lethal dose of 800 R. Fetal and placental weights from delayed implantation pregnancies are greater than those from normal pregnancies at comparable days of gestation. Experiments were performed which indicated that the hormone regimen and not the time spent in delay was responsible for the weight increase. (Disser. Abstr.)

Radiation Effects on Plants

Refer also to abstracts 47499, 47503, 47505, 47516, 47517, 47519, 47522–47525, 47538, 47574, and 48748.

47636 EXPERIMENTS ON THE IRRADIATION OF DUCKWEED (LEMNA MINOR L.) WITH γ-RAYS AND FAST NEUTRONS. Leinerte, M. P. (Inst. of Biology, Riga). Radiobiologiya, 8: 156-7(1968). (In Russian).

Duckweed was γ-irradiated at doses of 250, 1000, 4000, 16,000 and 64,000 rads and physically equivalent doses of fast neutrons. After two months, the number and weights of the plants were determined as percentages of a control. Very small doses of γ rays (up to 4000 rads) had a very weak effect, even a tendency to increase the weight at 250 and the number at 4000 rads; at 64,000 rads the number and weight were 30 to 40% of the control. Physically equivalent doses of fast neutrons had a much stronger effect: 80 to 90% of the weight and number of the control at 250 rads, 15 to 20% as 16,000, and 100% mortality at 64,000 rads. (JPRS)

47637 EFFECT OF γ-IRRADIATION OF SEEDS ON THE SURVIVAL, GROWTH, DEVELOPMENT, AND FRUITING OF ARABIDOPSIS THALIANA (L.) HEYNH. Ivanov, V. I.; Sanina, A. V.; Timofeeva-Resovskaya, E. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 8: 118-23(1968). (In Russian).

Arabidopsis thaliana (L.) Heynh. shoots 2- to 4-months old were irradiated with ^{60}Co γ-rays at doses of 10, 20, 40, 70, 110, 160, 220 and 290 kR at a rate of ~3.7 kR/min. They were placed at once on the surface of an agarized mineral nutrient medium and held in a light chamber that had a cycle of 20 hrs of light at ~25°C and 4 hrs of darkness at ~19°C. Phenological observations were made daily for 8 weeks; in addition, the length of the main root was measured on the 7th day and the total height of the plant on the 21st. The number of stalks was counted during the generative phase. The plant was found to be highly radioresistant, with LD_{50} of ~100 kR. Germination was affected least and was without decrease up to 300 kR. Most deaths occurred in the phases of cotyledonous leaves and rosettes but most plants surviving those phases up to ~160 kR reached fruit-bearing stages. The growth of root and stalk was halved at ~20 kR, the rate of vegetative development at ~70 to 100 kR, and the rate of generative development at ~40 to 70 kR. With increase of the dose the percentage of fruitful plants decreased (D_{50} = ~160 kR), as did the average number of seeds of fruitful plants (D_{50} = ~40 kR). Additional stems appeared on single-stemmed plants as a result of the irradiation. A rather close connection was found between the studied indicators of growth, development and fruitfulness. (JPRS)

47638 GROWTH AND SURVIVAL OF PTERIS LONGIFOLIA L. AS A FUNCTION OF THE DOSE OF X-IRRADIATION AND TIME OF SOWING OF SPORES AFTER IRRADIATION. Nefedova, A. I.; Verkhovskaya, I. N. (Inst. of Biochemistry, Moscow). Radiobiologiya, 8: 124-30(1968). (In Russian).

Dry spores of the fern, Pteris longifolia L., were x irradiated at 30, 60, 120, 240 and 350 krad at a dose rate of 17.2 krad/minute and 5, 10, 20, 25, 50, 100, 190, 280 and 370 krad at a dose rate of 4.7 krad/min. They were then sown after various intervals of time. The material was examined after 10, 20 and 30 days. It was found that the germination of spores and growth of gametophytes depended on the absorbed dose and the time between irradiation and sowing. At doses of 350 to 370 krad (sowing at once), 240 to 280 krad (sowing after a month) and 120 to 190 krad (sowing after a year), no spores germinated at all. The germination of spores and growth of gametophytes decreased with increase of the time between irradiation and sowing. The LD_{50} was 50 krad (sowing at once), 35 krad (sowing after a month) and 25 krad (sowing after a year). (JPRS)

47639 INFLUENCE OF THE STORAGE TIME OF IRRADIATED SEEDS AND THE FRACTIONATED DOSE OF γ IRRADIATION ON THE RADIOSENSITIVITY OF COTTON AND THE CHANGE OF RADIOSENSITIVY IN ONTOGENESIS. Nazirov, N. N.; Alimukhamedov, A. A. (Inst. of Experimental Biology of Plants, Tashkent). Radiobiologiya, 8: 111-17(1968). (In Russian).

Dry seeds of early-ripening radioresistant variety 1306-DV and late-ripening radiosensitive variety S-1622(16) of Gossypium hirsutum were irradiated at 5, 10, 15 and 20 kR doses of ^{60}Co γ rays at 23 R/sec and stored 1, 27, 63 and 127 days for both varieties and 3 years for S-1622 under room conditions, then soaked in water and sown. During the three year storage of seed irradiated with relatively massive doses, the biological effect of irradiation was intensified. Radiostimulation was expressed more strongly in the late-ripening than in the early-ripening variety. A single massive irradiation was more harmful than fractionated irradiation at the same dose. The processes of formation of morphological signs were more sensitive to irradiation than growth processes. The radiosensitivity of cotton varied noticeably during ontogenesis. High sensitivity appeared in the first period of development and reached a minimum toward the start of blossoming, which coincided with the moment of natural growth in height. (JPRS)

47640 RELATIVE RADIOSENSITIVITY OF NUCLEIC ACID (DNA AND RNA) SYNTHESIS, GROWTH AND MULTIPLICATION OF YEAST CELLS. Sokurova, E. N.; Korogodin, V. I. (Inst. of Biological Physics, Obninsk, USSR). Radiobiologiya, 8: 7-16 (1968). (In Russian).

Saccharomyces vini yeast cells, strain Megri V 139-V received a dose of 110 kR of ^{60}Co γ radiation (1 to 5% survival) and then were incubated for 30 hr. Samples were taken at various intervals and determinations were made of survival (microcolonies method), the number of cells, the percentage of gemmation, the quantity of biological mass, and the DNA and RNA contents. Without preventing first postirradiation gemmation, the irradiation inhibited further multiplication of the culture much more than it did RNA synthesis and growth of the biological mass. Synthesis of DNA had an intermediate position in radiosensitivity. (JPRS)

47641 USE OF IONIZING RADIATION TO INCREASE FROST RESISTANCE OF HYBRID APPLE VARIETIES. Petrov, D. F.; Liznev, V. N. (Inst. of Biology, Novosibirsk, USSR). Tr. Mosk. Obshchest. Ispyt. Prir., Otd. Biol., 23: 246-51(1966). (In Russian).

Experiments initiated in 1958 involved 3368 scions of nonfrost-resistant apple tree varieties, irradiated with ^{60}Co γ rays (4- and 5-kR doses) and with fast neutrons. After irradiation, the cuttings were grafted on the crowns of Malus baccata trees. Only six of the grafted scions remained in 1965, the rest were either destroyed, or badly injured by frost. The six hybrids of an apple tree, named Altay Sweet, which survived 6 Siberian winters, showed a higher degree of frost resistance and thus were propagated to produce 500 plants. The experiments revealed that the γ-ray doses used were unsuitable because they strongly suppressed the growth and development of plants, provided a low acclimatization of grafts, and induced much greater morphological changes than did fast neutrons. The effects of fast-neutron irradiation were more effective in stimulating the growth and abundant fructification of trees, but they lasted only two or three years. The results suggested that the ionizing radiation offered good prospects for the development of hybrid fruit trees. (BBB)

Radiation Effects on Microorganisms

Refer also to abstracts 47499, 47503, 47504, 47451, 47559, 47560, and 47574.

47642 PREVENTIVE EFFECT OF EXOGENIC INTERFERON IN CULTURES OF CHICKEN EMBRYONIC FIBROBLASTS AFTER X-IRRADIATION. L'vovskii, Z. A.; Kiselev, P. N. (Central Scientific Research Roentgeno-Radiological Inst., Leningrad. Inst. of Experimental Medicine, Leningrad). Radiobiologiya, 8: 154-6 (1968). (In Russian).

Chicken interferon was obtained by infection of 9 to 10 day embryos with virus of group A of strain PR_8 in a quantity of 10^4 chicken embryo doses. The allantoic fluid was taken 72 hr later and purified of influenza virus by centrifugation. The remaining virus was inactivated by heating and the interferon was diluted with 30-fold hemohydrolysate to reduce its activity. The inhibitory effect of interferon was determined by its inspection of its inhibition of the multiplication of vesicular stomatitis virus in normal and irradiated (200, 600 and 1800 rads of x-irradiation) cultures of chicken embryo fibroblasts. The antiviral activity of the interferon was reduced in the irradiated cultures in direct proportion to the dose and time elapsed between the irradiation and infection. (JPRS)

47643 THE OCCURRENCE OF PHOTOREACTIVATION AND THE EFFECT OF DIFFERENT SALT AND SUGAR CONCENTRATIONS IN THE RECOVERY MEDIUM ON ULTRAVIOLET-IRRADIATED SPORES OF BACILLUS STEAROTHERMOPHILUS. Lategan, P. M. (Univ. of the Orange Free State, Bloemfontein, S. Afr.). S. Afr. J. Agr. Sci., 8: 1015-19(Dec. 1965).

The effect of visible light on uv-irradiated spores as well as the influence of various concentrations of sugar and salt on the recovery of uv-irradiated spores was studied. Sugar and salt received attention because a mixture of these solutions is used in canning factories, especially in the canning of peas. The sugar in these solutions is usually contaminated with thermophilic spores. These two chemicals might, therefore, have an effect on the recovery of uv-irradiated spores. Photoreactivation of spores of Bacillus stearothermophilus was achieved after uv irradiation. The presence of sucrose in the medium had an advantageous effect on the development of irradiated spores and at a concentration of 10% sucrose reactivation was optimal. Irradiated and unirradiated spores were more resistant to the effect of sodium chloride in the medium at an incubation temperature of 65°C than at 50°C. At the higher salt concentrations, three times higher bacilli counts were found at an incubation temperature of 65°C than at 50°C. The effect of salt and sugar in the medium on colony formation should therefore be kept in mind especially if counts are to be made without previous dilution from solutions containing high sugar concentrations at sugar refineries, or directly from brine in canning factories. (BBB)

47644 PARTIAL REACTIVATION OF IRRADIATED PHAGE P1 BY STRAIN Bs2 OF ESCHERICHIA COLI. Donch, John; Greenberg, Joseph (Medical Research Foundation, Palo Alto, Calif.). Biochim. Biophys. Acta, 166: 271-3(Aug. 23, 1968).

Data are presented on host cell reactivation of T_3 phage in Escherichia coli strain B, Bs2, Bs1 and P1 · B in E. coli strain B, Bs2, Bs1, Bs1A and Bs1B. The data showed that strain Bs2 of E. coli, mutant in the exr cistron (phenotype that is HCR^+ but sensitive to both uv and x radiation), could effect maximum recovery of phage T1, T3, T7, P2, and λ but could not effect full recovery of phage P1. The same phenotype was produced by the exr gene of strain Bs1 but not by that of any of six other exr mutants of strain B. An explanation of the data is offerred. (B.S.L.)

47645 SPACE-FLIGHT EFFECTS AND GAMMA RADIATION INTERACTION ON GROWTH AND INDUCTION OF LYSOGENIC BACTERIA: A PRELIMINARY REPORT. Mattoni, R. H. T. BioScience, 18: 602-8(June 1968).

The Biosatellite II experiment employing lysogenic bacteria was planned to test whether weightlessness with and without radiation affected bacterial growth and structure and the mechanism regulating the induction of latent viruses. Comparison of results of two strains of lysogenic bacteria orbited and otherwise grown under nearly identical conditions on earth conclusively showed significant effects of space flight on several fundamental biological processes. Although the two strains grew at different rates, both produced significantly higher mean densities as a consequence of flight. The particular factor of space flight responsible was most likely reduced gravity, since growth of Salmonella typhimurium BS-5 (P-22)/P-22 was complete to stationary at reentry. Salmonella typhimurium also yielded relatively greater densities under γ irradiation (48%) than without irradiation (19%). The relatively more densely irradiated sets were ascribable, in part, to temperature effects as well as to more efficient repair of radiation damage. When expressed as the ratio of free phage per viable bacterium, yield decreased with increasing radiation in the space-flight cultures. The ratio of phage to bacteria density was consistently lower in flight populations. If the relative number of phage produced per bacterium was constant, these data indicated induction was less frequent during space flight. It was believed that the greater bacterial densities were a function of random cell distribution in the liquid medium under reduced gravity conditions. (BBB)

47646 TRANSFER OF MATERIALS IN BACTERIAL CONJUGATION: THEIR NATURE AND ROLE IN INDIRECT LYSOGENIC INDUCTION. Rosner, Judah Leon. New Haven, Yale Univ., 1967. 104p.

Thesis.

An upper limit for β-galactosidase (β-g) transfer between mating F+ and F− Escherichia coli was determined by a new technique for eliminating the β-g of the donor strain. The technique relies on selective lysis of the donor strain by heat induction of a thermoinducible strain of λ, accompanied by chymotryptic digestion of the released β-g. The experiments show that there is no significant transfer of β-g during mating between F+ and F− cells: 0.05 ± 0.05% of the enzyme originally present in the male cells is found in the female cells after one hour of mating at 37C. A factor, called the BR factor, is transferred during conjugation from a uv irradiated F+ cell to an F− cell. Such transfer results in prophage development in the F−. Interrupted mating experiments demonstrated that the BR factor and the sex factor, F, are transferred at identical times. By using an F-genote which carries a non-inducible prophage, it has been shown that F is transferred to the same cells that receive the BR factor. Nevertheless, cells that have become cured of a defective prophage, by virtue of receiving the BR factor, do not produce F+ clones. It was also observed that a proportion of uv-irradiated males are cured of F. These results are interpreted to mean that the BR factor is a uv-altered F which gradually becomes non-replicable. While still replicable, it may be transferred during conjugation to an F−. It is suggested that the presence of this altered F in the female disrupts the normal pattern of DNA metabolism with the consequence that phage development is induced. (Disser. Abstr.)

47647 EFFECT OF ACCELERATED HEAVY IONS ON VIRUSES AND CELLS. Schambra, Philip Ellis. New Haven, Yale Univ., 1962. 143p.

Thesis.

The relative killing efficiency of 1 MeV electrons, Co γ rays, and 10 MeV/amu helium, lithium, carbon, nitrogen, oxygen, fluorine, neon, and argon ions (LET range 2−18,000 (MeV-cm²)/gm) was investigated for T1 and O X 174 bacteriophages, and for E. coli and haploid and diploid yeast (in the interdivisional and budding states) under aerobic and anoxic conditions. The relative killing efficiency of these radiations on bacteriophages decreases as the LET increases. The relative killing efficiency of these radiations on cells is greater than unity for LET ~ 1000 (MeV-cm²)/gm, and decreases to less than unity above LET ~ 5000 (MeV-cm²)/gm. The relative killing efficiency of these radiations on the interdivisional yeast cell depends upon ploidy. The relative killing efficiency of these radiations on the budding yeast cell is independent of ploidy. The multiplicity observed in inactivation of budding yeast and interdivisional diploid yeast is independent of LET. Anoxic protection of cells decreases as LET increases. The limiting inactivation cross-section approached at high LET for E. coli and haploid interdivisional yeast is approximately the nuclear area. (Disser. Abstr.)

Radiosterilization and Radiopreservation

47648 (NYO-3422-1(Vol.3)) [SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (SWEET CHERRIES, APRICOTS, PRUNE-PLUMS)]. Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Jan. 31, 1966. Contract AT(30-1)-3422. 300p. Dep. CFSTI.

Body weight data for all male and female dogs maintained on all diets of irradiated apricots, plums, and sweet cherries along with data taken from control animals are presented in tabular form. Pathology reports and a summary of the findings for male and female dogs on all control and irradiated diets are also presented. There were no significant differences noted between replicates of each diet and the described lesions did not appear, histologically, to be related in any way to the irradiation of the food. (B.S.L.)

47649 (NYO-3422-1(Suppl.)(Vol.3)) [SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (ONIONS)]. Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Feb. 28, 1966. Contract AT(30-1)-3422. 125p. Dep. CFSTI.

Rats and dogs were maintained on a diet of irradiated onions. The effects of this diet on amount of food consumption, blood, intestinal enzymes, organ weights (body weights), and bone marrow were determined. Actual results for each individual animal and arithmetic means for every subgroup are presented. Certain

differences were biologically obvious as well as statistically significant. Many of these were related to sex in that male rats gained more weight and had heavier tissues. Many also were related to time and verify reports concerning the toxicity of an onion diet, especially in dogs. In relation to irradiation, most of the observed differences were very small. In many instances, even when a large number of rats was involved, the radiation effect was not statistically significant. One possible exception was in the gonads of dogs where the interaction between sex and radiation was significant at the 0.5 level; inspection of subgroups showed a tendency for an increase in size in males consuming the irradiated diet and a decrease in size in females. It was concluded that there was no evidence that irradiation of onions contributed any deleterious effect over and above the known toxicity of the onion diet. (B.S.L.)

47650 (NYO-3422-1(Vol.4)) [SHORT-TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS (SWEET CHERRIES, APRICOTS, PRUNE-PLUMS)]. Final Report. Gabriel, Karl L.; Edmonds, Russell S. (AME Associates, Princeton, N. J.). Jan. 31, 1966. Contract AT(30-1)-3422. 125p. Dep. CFSTI.

Rats were maintained on diets of irradiated apricots, cherries, and plums. Body weight, food consumption, hematology analyses, intestinal enzyme activity, and organ weights were monitored for variations from the norm. Actual results for each individual animal and arithmetic means for every subgroup are presented. Certain differences were biologically obvious as well as statistically significant. Most of these were related to sex in that male rats gained more weight and had heavier tissues. It was concluded that in terms of biological importance of the differences involved, there was no evidence of any deleterious effects due to irradiation of the foods. (B.S.L.)

47651 (NYO-3733-1) MICROBIOLOGICAL ASPECTS OF RADIOPASTEURIZED CHICKEN. First Quarterly Report. (Hazleton Labs., Falls Church, Va.). Dec. 9, 1966. Contract AT(30-1)-3733. 13p. Dep. CFSTI.

Progress is reported on the development of methodology for quantitative assessment of microbial flora of irradiated chicken precontaminated with organisms of known genera (Aerobacter aerogenes, Escherichia sp., Streptococcus sp., Salmonella sp., and Staphylococcus aureus). All cultures were obtained and purified for use. Generation of a psychrotrophic inoculum is outlined. The status of each culture for inclusion in the psychrotrophic inoculum with respect to initial radiation cycles is described. In general, all irradiated cultures appeared to have developed reduced growth rates on differential media. (B.S.L.)

47652 (ORO-660) RADIATION PASTEURIZATION OF GULF SHELLFISH. Annual Report, January 1-December 31, 1967. Novak, Arthur F.; Liuzzo, Joseph A. (Louisiana State Univ., Baton Rouge. Dept. of Food Science and Technology). Jan. 30, 1968. Contract AT(40-1)-2951. 44p. Dep. CFSTI.

The results obtained during 1967 continue to affirm the feasibility of radiation pasteurization as a method of preserving and extending the iced-shelf life of fresh shrimp and oysters. One of the most important requisities for the successful preservation of shellfish by radiation was that the product be of good quality prior to irradiation. Tests to rapidly and accurately determine this freshness quality were investigated. Measurements of the viscosity of shrimp homogenates and of the concentration of carbonyls both showed promise. Perfection of these determinations could also serve as a quality control measure for changes during and after irradiation. Metabolic studies with bacteria that survive low-level radiation continued to show the benefits of radiation in reducing the production of undesirable by-products during storage of oysters. For years, the decrease in the synthesis of these bacterial products was assessed as a reduction in number. However, data presented show that a reduction in numbers is not the only cause. When inoculum numbers were standardized, a reduction in by-product synthesis was still evident, thereby, indicating a change in the metabolic system of bacteria that was induced by radiation. One of the most fruitful studies showed that low-level radiation did not alter the proximate composition of oysters. Crude protein was the only nutrient significantly affected by low-dose radiation. Even though decreases were observed in some instances (ash, NPN, and true protein), no significance was attached to their decrease in concentration. Ash and glycogen content were significantly affected by iced-storage. (auth)

47653 STUDY OF THE POSSIBLE CONTROL OF RHODNIUS PROLIXUS BY MEANS OF IONIZING RADIATIONS. Gomez-Nunez, Juan C. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Acta Cient. Venez., 18: Supl. 3, 98-105 (1967). (In Spanish).

In a feasibility study of the use of x and γ radiation for R. prolixus control, both the sterile male technique and the introduction to lab populations of specimens with detrimental lethal characteristics were examined. Complete sterility was attained after an exposure to 17,500 R but exposures to 7500 R or more impaired normal behavior. This prevented the use of the sterile male technique since irradiated individuals were unable to compete with normal ones. However, males exposed to 5000 R, although 25% fertile, became more active in mating and their descendants from normal females had a significantly higher mortality rate than normal nymphs. To observe the population effects of the introduction of these males, they were introduced in different ratios to normal males in five lab populations. In all cases, density fell until the appearance of the fourth generation; afterwards all recovered and some reached higher than normal densities. Evidently irradiation accelerated the normal evolutionary process of adaptation creating a strain of R. prolixus better adapted to its flask environment, at least temporarily. (BBB)

47654 COCKCHAFER AGAINST COCKCHAFER: AN EXPERIMENT FOR ERADICATION OF MELOLONTHA VULGARIS FABR. LARVAE WITH X-IRRADIATED MALES. Horber, Ernst (Eidgenoessische Landwirtschaftliche Versuchanstalt, Zurich). Waldhygiene, 6: 161-70(1966). (In German).

The sterile-male technique was used in a field trial in attempts to eradicate the white grub. Tests of various doses of x rays from 1000 to 20,000 R revealed that the minimal dose to sterilize the males was 3000 R. Thus a dose of 3325 R of 200-KV x rays, at 665 R/min, was used to prepare the males. During two flight periods (1959 and 1962) irradiated males were released in an area (A) with a surface of about 30 ha. Gradation in that area as well as in three control areas (C) was observed since 1953. In 1959, for the first treatment, about 3100 sterilized males were released in A, representing about 50% of the male population. The white grub infestation sampled in grassland dropped thereafter to about $\frac{1}{5}$ of that in the other areas. The reproduction rate remained less than unity in A only. Further reduction of the population in A to $\frac{1}{10}$ of that in the control areas was observed when the number of surviving cockchafers was estimated in the spring, 1962. The greatest mortality from 1959 to 1962 occurred in area A. In 1962, for the second treatment, 8594 irradiated males were released in A. Between 76 and 100% of the male population of A was irradiated. Subsequent sampling of the white grub population showed complete eradication in A. In the last flight period, in 1965, no treatment was necessary, since only a few cockchafers occurred in A, whereas their number had increased in the control area C, 1 to 3. It was demonstrated that the sterile-male technique may be successfully applied to an insect pest in an area that is not strictly isolated geographically, the females of which mate several times, the artificial breeding of which in large quantities is not feasible because of the long development cycle, and the most voracious and destructive stages of which live in the soil. (BBB)

47655 INFLUENCE OF GAMMA RADIATION ON TEXTURAL CHANGES IN PEACHES. Braddock, R. J.; Dennison, R. A.; Ahmed, E. M. (Univ. of Florida, Gainesville). Proc. Fla. State Hort. Soc., 79: 281-4(1966).

Textural changes after γ irradiation were measured in a shear press in peaches of the Maygold, Southland, Loring, and Dixiland varieties. Maygold peaches were irradiated at levels of 0, 100, 200, and 300 Krad and then stored at 67°F and 92% relative humidity (RH) for 1, 4, and 6 days. Irradiation induced softening of the fruit; however, the rate of softening was greatest for peaches measured after 1-day storage. Results showed a significant irradiation x-storage interaction with the percentage change in maximum shear force increasing with higher levels of irradiation. Texture measurements were made on the Southland, Loring, and Dixiland varieties immediately following irradiation in order to eliminate the storage effect. The percentage change in maximum shear force was linearly proportional to the log of the irradiation dose. Correlation coefficients for the relation between the percentage change in maximum shear force and the log of the dose for the Loring, Southland, and Dixiland peaches were 0.98, 0.96, and 0.98, respectively. No rate of change was apparent for the Loring and Dixiland varieties until 100 Krad; hence, the correlation coefficients and the regression lines did not reflect the values for 0 and 50 Krad in these 2 varieties. The rate of percentage change was not as great for the Loring peaches as for the Southland and Dixiland varieties. (BBB)

47656 RESEARCH WITH IONIZING RADIATION ON STERILIZATION AND RADIOSENSITIVITY OF CHRYSOMELA DECEMLINEATA SAY. Cavalloro, Raffaele; Cirio, Ugo (EURATOM, Ispra, Italy). Redia, 50: 365-77(1966-1967). (In Italian).

A study was made on the radiosensitivity and radiosterilization of Chrysomela decemlineata Say for possible application of the sterilized male technique to this pest of the Solanaceae family

(particularly of the potato plant). Optimal conditions of day and night temperature, relative humidity, photoperiod, light intensity and diet, were first determined in order to produce large number of insects in a controlled environment chamber. Irradiation with 200 kV x rays showed that radioresistance increased with the development of the insect; thus the exposure doses resulting in 30% lethality increased in the ratio 1 to 60 to 240 for one-day-old eggs, one-week-old pupae and three-day-old adults, respectively. Radiation resulted in increased mortality of the offspring, especially at molting and a lengthening of the various larval instars as well as a reduction of the life-span of adults irradiated as such or emerging from irradiated pupae. The minimum exposure dose for sterilization of both sexes was determined accurately; it proved to be 3000 R for pupae irradiated three days before the end of metamorphosis. This dose did not alter the sexual vigor of the insect. It would appear that the sterile male technique may be used in controlling this pest. (auth)

47657 USES OF IONIZING RADIATION AND RADIOACTIVE ISOTOPES IN AGRICULTURAL ENTOMOLOGY. Cavalloro, Raffaele. Tabacco, 65: No. 700, 1-16(July-Sept. 1960). (In Italian).

The relations between man and insects on the competitive plan of the struggle for existence is discussed. The use of radioactivity in entomology for examining the behavior of insects exposed to the radiations is then considered. Two different fields of application are distinguished: ionizing radiations and radioisotopes. The former aims at the destruction of dangerous insects that can be obtained either directly, the ones that can be easily reached in their natural habitat or in the trophic places, or indirectly by causing sterility of adults or by causing such changes to the germinal cells as to provoke dominant lethal characters. The latter aims at studying and improving the knowledge of the constitution, biology, and ecology, of insects. The types of radiations and the radioactive elements used are discussed; data and results are included. (70 references,) (auth)

47658 CONTROL OF HARMFUL INSECTS IN AGRICULTURE BY USE OF IONIZING RADIATION. Cavalloro, Raffaele (EURATOM, Ispra, Italy). Boll. Ist. Entomol. Agr. Osserv. Fitopatol. Palermo, 7: No. 56, 101-12(1967). (In Italian).

Economic aspects of the use of ionizing radiations for the control of agriculturally important insect pests are reviewed. Both the sterile male technique and radiation processing of fruits, vegetables, and cereals are included. (B.S.L.)

47659 THE PRESENT DAY STATUS AND PERSPECTIVES OF IRRADIATION AS A TOOL IN FOOD AND FEED TECHNOLOGY. Mossel, D. A. A. Verpakking, 18: 466-76(1966).

The uses of ^{60}Co and electrons from accelerators as sources of ionizing radiation in food technology are discussed. Sterilizing effects of radiation on microorganisms and insects infesting grain, dried fruits, and tobacco, and effects of ionizing radiation on the keeping quality of food products are reviewed. Measures that tend to reduce or mask the undesired chemical effects of radiation, such as a reduced temperature and addition of flavoring agents, are discussed. Problems concerning the wholesomeness of irradiated foods are reviewed. It is pointed out that there is no possibility of induced radioactivity when ^{60}Co and ^{137}Cs are used as sources. Studies on the losses of nutrients induced by irradiation show that no severe losses occur in proteins, carbohydrates, or fats; however, there is a loss of vitamins in some foods. The presence of toxic compounds in irradiated foods was investigated by feeding irradiated food to rats and pigs; no evidence of toxicity was found. The most promising uses of ionizing radiation in food processing appear to be in the area of animal feeds. (H.L.W.)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Corrosion and Erosion

47660 (CONF-671007-2) SOME ASPECTS OF MATERIALS TECHNOLOGY OF IMPORTANCE TO THE DEVELOPMENT OF NUCLEAR REACTORS. Nichols, R. W. (United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Group); Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group). [1967]. 51p. Dep.

From International Nickel Company Power Conference, Lausanne, Switzerland.

Several aspects of the development of metallic materials for use in the British nuclear power program are discussed. The effects of irradiation and corrosion on structural materials in the Advanced Gas-Cooled Reactor and the High Temperature Gas-Cooled Reactor are described with particular mention of the influence of resistance to corrosion on the selection of materials for heat-exchanger tubing and for thermal insulation foils. Corrosion resistance was also important in the selection of a cladding material for the A.G.R. but recent work has been concerned with increasing its ductility under tube-burst and cyclic strain conditions. A major program of experiments involving a statistical examination of this problem has highlighted the advantages accruing from use of a fine metallurgical grain size. With respect to the Steam Generating Heavy Water Reactor, mention is made of the assessment of zirconium alloy pressure tubes for hydrogen and irradiation embrittlement and a technique based on measuring the critical crack opening displacement is described which may be of general value for assessing fracture toughness in relation to engineering designs. Several aspects of the corrosion and mass transfer of metals in liquid sodium are mentioned, and the similarity in behavior of a wide range of different steels is noted. There are, however, considerable differences in the rates of carbon transfer from different steels in sodium, and it is necessary in selecting steels for use in a sodium-cooled fast reactor to choose those with suitable alloying additions to resist decarburization. Aspects of the effect of neutron irradiation in reducing the high-temperature ductility of austenitic steels and nickel alloys are mentioned, and the importance of controlling the grain-size and precipitate distribution in such materials is indicated. (auth)

47661 (CONF-671007-6) EXPERIENCE AND SELECTION OF CONDENSER MATERIALS FOR POWER PLANTS. Gasparini, R.; Sturla, P. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). [1967]. 23p. Dep.

From International Nickel Company Power Conference, Lausanne, Switzerland.

The importance of more thorough understanding of materials used in condensers is explained in terms of the need for the highest integrity in condensers of conventional and nuclear power units now being installed. Such integrity is hampered by the sheer size of the units involved and by the increasing necessity to use relatively aggressive cooling waters. Tubes of aluminum brass, cupro-nickel alloys and stainless steel are the most commonly used in modern condensers and various aspects of each are considered in detail. The importance of correct storage of aluminum brass tubes before service is illustrated and the value of iron sulfate treatment in generating a protective surface film on such tubes in seawater is highlighted by reference to trials at Latina. Consideration is given to the application of copper-nickel alloys where polluted or highly erosive seawaters are involved, and in the non-condensable gas zones of condensers where aluminum brass is liable to serious attack. Reference is made to rapid growth in the use of stainless steel condenser tube, the advisability of using this tube in a seawater environment is discussed with particular reference to the operating conditions and precautions necessary to avoid pitting. Attention is drawn to current interest in tube plates clad with cupro-nickel or stainless steel. Good results are reported for a unit equipped with a stainless-clad tube plate operating in seawater, at the site where poor performance had been obtained with stainless tubes. Galvanic corrosion problems can arise in condensers fitted with coated mild-steel waterboxes and cathodic protection devices. The desirability of utilizing tube plates and waterboxes in the material of which the tubes are made to overcome these problems is stressed, and reference is made to the possibilities of cladding these two components with, for example, cupro-nickel alloys. Reference is made to condenser shells and other components generally made in mild steel. These are subject to serious corrosion, particularly under shut-down conditions, and attention is drawn to the importance of considering conservation techniques such as flooding with water to protect these components on shut-down. (auth)

47662 THE OXIDATION OF TANTALUM AT HIGH TEMPERATURES: GEOMETRICAL EFFECTS. Stringer, J. (Univ. of Liverpool). J. Less-Common Metals, 16: 55-64(Sept. 1968).

Tantalum specimens in the form of short tubes were oxidized at 825° and 930°C in oxygen at a pressure of approximately 400 torr. The external diameters of all the specimens were the same, and the internal diameter was varied. The oxidation rate of the inner surface decreased with decreasing radius of curvature, but the rate on the outer (convex) surface was approximately the same as that on the inner (concave) surface for the thinner-walled tubes. During oxidation the metal tubes dilated because of the stresses generated at the oxidizing surfaces. The results suggest that the major source of this stress is in the adherent part of the oxide scale rather than in the surface layers of metal affected by solution of oxygen. (auth)

47663 THE DEVELOPMENT AND TESTING OF PROTECTIVE COATINGS ON F48 AND SUI6 NIOBIUM ALLOYS. Restall, J. E. (National Gas Turbine Establishment, Farnborough, Eng.). J. Less-Common Metals, 16: 11-36(Sept. 1968).

A silicide-glaze composite coating was developed that protects F48 and SU16 niobium alloy during laboratory oxidation tests at temperature up to 1300°C and has useful creep resistance at temperatures up to 1250°C. The oxidation resistance of the coating compared favorably with a Cr–Ti–Si coating developed commercially in the U.S.A., and was found to be superior to several other experimental coatings. (auth)

47664 COMPARISON OF THE CURVES OF THE VARIATION OF THE MICROHARDNESS AND OF THE CONCENTRATION OF DISSOLVED OXYGEN IN α ZIRCONIUM AFTER PROLONGED OXIDATION AT 850°C. Amsel, Georges; Beranger, Gerard; Boisot, Pierre; David, Daniel; de Gelas, Bernard; Lacombe, Paul (Ecole Normale Superieure, Paris. CNRS, Paris). Compt. Rend., Ser. C, 301-4(July 22, 1968). (In French).

The profiles of hardness and of the concentration of dissolved oxygen were determined in the metal underlying the oxide for samples of zirconium oxidized for 400 hr at 850°C. It was shown that the degree of hardness did not correspond to the oxygen concentration. This last, established with the aid of the nuclear reaction $^{16}O(d,p)^{17}O^*$, with a precision better than 2%, was adjusted to an error function complement on the major part of the diffusion curve. (tr-auth)

47665 EFFECTS OF THERMAL CYCLING ON THE OXIDATION BEHAVIOUR OF AN AUSTENITIC STEEL IN CO_2. Francis, J. M.; Lee, C. J.; Buddery, J. H. (Central Electricity Generating Board, Berkeley, Eng.). J. Iron Steel Inst. (London), 206: 921-4 (Sept. 1968).

A detailed analysis of nonadherent oxide samples derived from a 20%Cr–25%Ni–Nb stabilized steel under both steady state and thermal cycling conditions is described for the temperature range from 750 to 900°C. The composition data were closely correlated with the weight gain results, showing the incidence of spalling, and a mechanism for the mode of scale-cracking is discussed on this basis. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 47289, 47290, and 47303.

47666 (DP-1152) QUALITY ASSURANCE SPECIFICATIONS AND TESTING METHODS FOR BONDED COBALT SLABS. Holgate, E. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). July 1968. Contract AT(07-2)-1. 12p. Dep. CFSTI.

Quality assurance specifications have been established and test procedures have been developed for the production of stainless steel-bonded slabs of irradiated cobalt. This program assures that the cladding is sound and that the dimensions will allow each slab to be placed into a second standard sheath. (auth)

47667 (RFP-Trans-37) PROCESS OF ARC WELDING UNDER GAS PRESSURE AND APPARATUS FOR CARRYING OUT THE PROCESS. Bridoux, Claude; Foulquier, Henri; Kauffmann, Jean; Thome, Paul. Translation of French Patent 1,313,195. 9p. Dep. CFSTI.

The air-tight arc welding of materials that must be isolated from the operator is described. The welding is carried out, under

a controlled atmosphere, at a pressure above atmospheric pressure. The apparatus consists of the following parts: a workable welding chamber, equipped with a spindle-carrying piece, driven by a motor, into which an adjustable electrode plunges; a turning tube; and means for conducting gas under pressure into this enclosure. (M.C.G.)

47668 METALLURGY UNDER VACUUM. Guichard, C.; Sifferlen, R.; Soret, J. C. Bull. Inform. Sci. Tech. (Paris), No. 126, 67-79(May 1968). (In French).

The mechanical and physico-chemical principles of metallurgy under vacuum (variation of free enthalpy, kinetics of a reaction) are recalled and it is shown how they are applied to some operations such as dehydrogenation of uranium, denitrogenation of steel, refining, and decarbonization. The different applications are then passed in review: degassing of liquid metals, melting and remelting, heat treatments, sintering, welding; recent work in this field is quoted by way of example. (auth)

47669 THE ELECTRON BEAM MELTING OF THE REFRACTORY METALS. 11. DUCTILITY OF ELECTRON BEAM MELTED Nb ALLOY INGOTS. Takaai, Tetsuya (Hitachi Ltd., Japan). Nippon Kinzoku Gakkaishi, 32: 802-7(Aug. 1968). (In Japanese).

Ductility of electron beam melted Nb alloy ingots was studied mainly by the Charpy impact test and the tensile test. Marked differences of room temperature ductility between Nb–Zr (NZ) alloy ingot and Nb–Zr–Ti (NZT) alloy ingot were observed. That is, the NZ alloy fractured in a brittle manner at room temperature contrary to the ductile fracture of the NZT alloy ingot and repeated twin formation was noticed for only the NZT alloy ingot during the tensile test. The transition temperature of the NZ alloy ingot due to the Charpy impact test was about 250°C and 250 ~ 330°C higher than the NZT alloy ingot. The room temperature ductility of Nb–Zr alloy ingot was influenced strongly by the zirconium concentration and an abnormal brittle fracture was observed for only the Nb–30% Zr alloy ingot, while there was no remarkable correlation between the O_2 gas content and the ingot ductility, and titanium was assumed to be equivalent to zirconium. (NSA of Japan)

47670 PRODUCTION OF Nb-PLATED Ti28V BIMETAL BY EXPLOSION METHOD. Kalinin, G. P.; Elyutin, O. P.; Vaulinskii, E. S.; Kudinov, V. M. Tsvetn. Metal., No. 7, 75-7(July 1968). (In Russian).

A sheet of alloy prepared from pure iodide titanium and vanadium by electron beam melting and plated with Nb by explosion welding, were cold rolled into a quality strip with intermediate vacuum compression of 40 to 50% and intermediate vacuum annealing at 750 to 800°C. (R.V.J.)

Properties Evaluations

Refer also to abstract 48063.

47671 (CONF-671007–3) MATERIALS CONSIDERATIONS FOR WATER-COOLED NUCLEAR POWER REACTOR SYSTEMS. Claudson, T. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1967]. Contract AT(45-1)-1830. 85p. Dep. CFSTI.

From International Nickel Company Power Conference, Lausanne, Switzerland.

The proper selection of materials for reactor application depends upon mechanical properties, fabricability, availability, compatibility with the reactor coolant, and the nuclear and physical properties of the material. Work related to the determination of the effects of irradiation and environment on the mechanical properties and corrosion of zirconium, stainless steel, nickel-base, and pressure vessel alloys for components acting under normal service conditions has been performed. Data from this work as applied in design of water-cooled power reactor systems are presented. While general corrosion problems associated with the long-term operation of reactor power stations have been solved, accelerated corrosion rates and hydrogen absorption have been found in zirconium alloys and must be considered in reactor design. The mechanical properties of zirconium alloys are affected by both environment and neutron fluence wherein strength is increased by factors of three after a fast fluence level of 8×10^{21} n/cm^2. Ductility of the material as measured by uniform elongation is less than one percent, indicating that only a minimum amount of ductility is available to accommodate fuel swelling and strain due to pressure and thermal stresses. Postirradiation mechanical property tests on austenitic stainless steels show a drastic non-recoverable loss in elevated temperature ductility. At fast fluence levels above 6×10^{21} n/cm^2, uniform elongation below one per cent can be expected. Similarly, with decreased strains, severe reductions in rupture life can be expected as compared with unirradiated material. Nickel-base alloys generally have adequate corrosion resistance and may be used in thermal reactor systems where cost and neutron economy do not limit their acceptance and where high strength and good wear resistance are required. Loss in high-temperature strength and ductility due to irradiation similar to that of stainless steel can be expected. Shifts in the ductile-brittle transition temperature of 400 to 600°F and greater have been observed in nuclear pressure vessel materials making more possible a brittle catastrophic failure in the vessel. While postirradiation annealing has been found to recover most of the damage, the effects of annealing on the ultimate properties are not known. Fracture toughness data indicate that reduced toughness which must be taken into consideration can be expected. (auth)

47672 (CONF-671007–5) MATERIALS PROBLEMS AND REQUIREMENTS ASSOCIATED WITH THE DEVELOPMENT OF STEAM TURBINES AND ALTERNATORS. Montandon, R.; Endres, W. (Brown, Boveri and Co., Ltd., Baden (Switzerland)). [1967]. 23p. Dep.

From International Nickel Company Power Conference, Lausanne, Switzerland.

Materials requirements associated with the various parts of large steam turbines and the associated generators are summarized and indications given of the developments that can be expected in the next few years. With the tendency to limit steam pressure and temperature to currently used levels, emphasis is on increasing sizes of plant. From the materials point of view, it is expected that heavy components, e.g., rotor forgings, and casings, will continue to be made in established steels using, more and more, welded construction. There is, however, interest in generator rotors with improved magnetic properties and more particularly in improved materials for low pressure turbine blading and for generator end bells. (auth)

47673 (COO–1198–564) THE FREQUENCY DEPENDENCE OF DISLOCATION DAMPING IN B.C.C. NIOBIUM. Ganguly, Bidyut Kumar (Illinois Univ., Urbana). Aug. 1968. Contract AT(11-1)-1198. 36p. Dep. CFSTI.

Thesis.

The frequency dependence of the amplitude-independent dislocation damping in high purity niobium single crystals was measured in the megacycle frequency range. Measurements of the dislocation contribution to the elastic modulus were also carried out in this frequency range. The results are discussed in terms of a theoretical calculation which treats the dislocation as a pinned vibrating string which experiences a viscous drag proportional to its velocity. The data are consistent with a curve of the form $K\,\omega\tau/1 + \omega^2\tau^2$ as calculated from the vibrating string model. On the high frequency side of the maximum, the dislocation damping exhibited a ω^{-1} dependence as expected from the theory. The effect of various interstitial solute contents on the damping was shown to be consistent with the calculated dependence of the damping on pinning point concentrations. The viscous damping constant was calculated from the damping and from etch pit determinations of the dislocation density to be about 9×10^{-5} dyne-sec per cm^2. Within the experimental precision the modulus defect was found to be independent of frequency and to increase with increasing interstitial concentrations. (auth)

47674 (DP–1108) MEASUREMENT OF THE PERMEABILITY OF METALS TO HYDROGEN AT ROOM TEMPERATURES. Dexter, Arthur H. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr. 1968. Contract AT(07-2)-1. 16p. Dep. CFSTI.

Previous measurements of hydrogen permeation of metals have been limited to high temperatures where permeation rates are relatively high and pressure-sensing devices can be employed-to-measure the permeating gas. Permeation rates at room temperature can be measured by the use of tritium (the radioactive isotope of hydrogen) and conventional counting equipment. With the equipment and techniques described in this report, it is possible to measure hydrogen permeation rates on the order of 10^{-17} cm^3 (STP)/(sec) (cm^2) per mm thickness of metal. (auth)

47675 (ORNL–4254, pp 183-240) MATERIALS DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Progress is reported on the development of the primary structural materials for molten salt reactors. These materials are Hastelloy N and graphite. Topics covered include: MSRE surveillance program, graphite studies, Hastelloy N, graphite-to-metal joining, and support for components development program. (R.C.K.)

47676 (N–68–24477) YIELDING AND FRACTURE IN TUNGSTEN AND TUNGSTEN–RHENIUM ALLOYS. Raffo,

Peter L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1968. 36p. (NASA-TN-D-4567). CFSTI.

A study was made of the mechanical properties of vacuum arc-melted tungsten and tungsten–rhenium alloys at 77 to 810°K in order to elucidate the mechanism by which rhenium additions lower the ductile-brittle transition temperature of tungsten. The temperature and strain-rate dependence of the yield stress of tungsten is reduced by alloying with rhenium. This is shown to be because of a reduction in the Peierls stress. The reduction in the transition temperature is attributed to the reduced Peierls stress through its effect on the mobility and rate of multiplication of dislocations. (auth)

47677 INTERSTITIAL IMPURITY EFFECTS ON THE MECHANICAL PROPERTIES OF MOLYBDENUM SINGLE CRYSTALS. Lau, S. S.; Dorn, J. E. (Univ. of California, Berkeley). Scr. Met., 2: 335-9(June 1968).

An investigation was made on the effects of interstitial impurity content on the athermal stress, τ_A, and the effective stress τ^*, of molybdenum single crystals oriented most favorably for $(\bar{1}01)$ [111] slip. Experimental results indicate that the athermal stress level is raised as the carbon content increases. It is concluded that interstitial impurity content affects only the athermal stress. The Peierls theory was chosen as the model which best accounts for the strong temperature dependence of flow stress of bcc metals. (J.G.B.)

47678 ON SELF DIFFUSION IN ALPHA ZIRCONIUM. Naik, M. C.; Agarwala, R. P. (Bhabha Atomic Research Centre, Trombay, India). Scr. Met., 2: 315-17(June 1968).

Values for self-diffusion in zirconium were calculated and compared with previously reported results. (J.G.B.)

47679 CALCULATION OF THERMAL AND ELECTRIC CONDUCTIVITY OF POROUS TUNGSTEN BY THE FORMULAE OF GENERALIZED CONDUCTANCE. Mal'ko, P. I.; Nemchenko, V. F.; L'vov, S. N. (Kherson Teacher's Inst., USSR). Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 55-9(July 1968). (In Russian).

The dependence of thermal conductivity coefficient and resistivity of tungsten with porosity from 0 to 45% was investigated over the temperature range from indoor temperature to 1500°K. General regularities are found in the thermal conductivity coefficient and resistivity depending on temperature and porosity. The possibility of calculating these coefficients at various temperatures and porosities by the formula of generalized conductance is analyzed. (auth)

47680 SOLUTION HARDENING AND DEFORMATION OF NIOBIUM–TUNGSTEN ALLOYS. Harris, B. (Univ. of Sussex, Brighton, Eng.). Phys. Status Solidi, 29: 383-90(Sept. 1, 1968).

The results of experiments on the strain-rate and temperature dependence of the flow stress of dilute niobium–tungsten alloys are reported. Alloys containing 0.25, 0.5, and 2.6 at. % tungsten exhibit unusual twin peaks in the strain-rate sensitivity as a function of temperature, and this leads to abnormally high values of the activation energy of deformation in the region of 150°K. And yet the behavior of a 5.3 at. % W alloy appears to be identical with that normally observed for bcc metals. The results suggest that two deformation mechanisms are overlapping below 150°K, and current theories of solute hardening and deformation of bcc metals are examined to provide an explanation. (auth)

47681 HIGH-TEMPERATURE DUCTILE ALLOYS. Friedman, Sam (to General Telephone and Electronics Labs., Inc.). U. S. Patent 3,395,013. July 30, 1968. Filed Mar. 29, 1965.

A group of tungsten-base alloys containing between 1% and 10% rhenium, carbon, and a reactive metal from the group consisting of hafnium, zirconium, and titanium are covered. These low rhenium-content alloys may be used to fabricate wrought forms having high strength at elevated temperatures, high recrystallization temperatures and low ductile-to-brittle transition temperatures. (auth)

47682 CERIUM DIFFUSION IN DELTA STABILIZED Pu–Ce ALLOYS. Harvey, M. R.; Rafalski, A. L.; Riefenberg, D. H. (Dow Chemical Co., Golden, Colo.). ASM (Amer. Soc. Metals) Trans. Quart., 61: 629-31(Sept. 1968).

Diffusion couples were made by hot pressing alloys containing 3.74 and 7.17 wt. % Ce together. They were annealed at 403 to 528°C for 8 to 76 days and the resulting Ce profiles analyzed with an electron microprobe. The diffusivity fell in the range of 10^{-10} to 4×10^{-12} cm²/sec; an Arrhenius plot gives the following equation: $D = 1.31 \times 10^{-2} \exp(-29{,}600/RT)$. (D.L.C.)

Structure and Phase Studies

47683 NEW NON-CRYSTALLINE PHASES IN SPLAT COOLED TRANSITION METAL ALLOYS. Ray, R.; Giessen, B. C.; Grant, N. J. (Massachusetts Inst. of Tech., Cambridge). Scr. Met., 2: 357-9(June 1968).

A modification of the previously reported splat cooling method of rapid quenching was used for studying alloys of five binary transition metal systems. Zr–Ni, with 20 to 40 at. % Ni, Zr–Pd, with 20 to 35 at. % Pd, Zr–Cu, with 40 to 75 at. % Cu, Zr–Co, with 28 at. % Co, and Ti–Cu, with 65 to 70 at. % Cu, were rapidly quenched from the melt to room temperature at cooling ranges calculated to be between 10^5 and 10^{7}°C/sec. X-ray diffraction analysis indicated a near 100% yield of noncrystalline phases. However, electron microscopy indicated the existence of some crystalline regions. The occurrence of broad noncrystalline phase fields indicates that low melting eutectics are not necessary for the formation of these phases. (J.G.B.)

47684 ELECTRON MICROSCOPIC OBSERVATIONS OF DISLOCATIONS IN NICKEL AND Ni–Mo ALLOYS. Brooks, C. R. (Univ. of Tennessee, Knoxville); Spruiell, J. E.; DuBose, C. K. H. Mater. Res. Bull., 3: 381-8(May 1968).

Dislocations induced by deformation of disordered fcc 10 and 20 at. % Mo–Ni alloys are closely restricted to the slip planes and pile up readily at barriers. It is believed that Mo lowered the stacking fault energy to cause sufficient separation of partial dislocation pairs so that cross-slip is difficult; however, the stacking faults were not resolvable, indicating that the separation was less than about 10 Å. The microstructure of the deformed ordered Ni_4Mo was characterized by numerous long ribbons which were assumed to be contrast effects caused by the formation of antiphase boundaries as dislocations passed through the domains. Dislocations were restricted to single slip planes, and appeared nearly always in pairs, which were concluded to be superdislocations. (auth)

47685 MAGNETIC AND STRUCTURAL CHARACTERISTICS OF $TiCr_2$, $ZrCr_2$, $HfCr_2$, AND THE $TiCo_2$–$ZrCo_2$ AND YFe_2–YCo_2 ALLOY SYSTEMS. Abei, A. W.; Craig, R. S. (Univ. of Pittsburgh). J. Less-Common Metals, 16: 77-83(Oct. 1968).

The hexagonal modifications of the Laves phases $TiCr_2$, $ZrCr_2$, and $HfCr_2$ all exhibit Pauli paramagnetism with nearly the same susceptibility values ($\approx 4 \times 10^{-4}$ e.m.u./mole). Measurements on the cubic modification of $TiCr_2$ yield a slightly higher Pauli paramagnetic susceptibility (5×10^{-4} e.m.u./mole). The compounds $TiCo_2$ and $ZrCo_2$ form a single phase pseudo-binary system having the cubic Laves phase structure. The compounds exhibit Pauli paramagnetism with virtually constant susceptibility (1.44 to 1.53×10^{-3} e.m.u./mole) over the entire composition range. The YFe_2–YCo_2 system is also single phase with the cubic Laves structure. These alloys are ferromagnetic over the entire composition range. As Co is substituted for Fe in YFe_2 the saturation moment increases, passing through a maximum at the composition $YFe_{1.4}Co_{0.6}$. The striking similarity to the behavior of alloys of elemental Co and Fe is pointed out. (auth)

47686 LANTHANUM–LEAD SYSTEM. McMasters, O. D.; Soderquist, S. D.; Gschneidner, K. A. Jr. (Ames Lab., Iowa). ASM (Amer. Soc. Metals) Trans. Quart., 61: 435-41(Sept. 1968).

The lanthanum–lead phase diagram was established on the basis of data obtained by x-ray diffraction, metallographic, and differential thermal methods. An inverted peritectic reaction develops as a result of lead additions lowering the 870°C transformation temperature of lanthanum to 840°C. Eutectic reactions occur at 10.5 at. % Pb and 775°C and at 64.5 at. % Pb and 1090°C. Lanthanum additions lower the 327°C melting point of lead to 325°C and consequently a eutectic reaction occurs at this temperature. Intermetallic compounds La_3Pb_5 and $LaPb_3$ melt congruently at 1450 and 1160°C, respectively. The peritectic decomposition temperatures for La_4Pb_5, La_2Pb_3, and $LaPb_2$ are, respectively, 1420, 1190, and 1105°C. An allotropic transformation occurs in La_2Pb_3 at 715°C upon heating. A sixth compound of approximately the $La_{11}Pb_{10}$ stoichiometry was found to exist in the temperature range from 1160 to 1350°C. The crystal structures of the compounds are discussed. (auth)

47687 CONTINUOUS-COOLING TRANSFORMATION DIAGRAMS OF Ti–8Al–1Mo–1V. Wu, K. C. (Northrop Norair, Hawthorne, Calif.). ASM (Amer. Soc. Metals) Trans. Quart., 61: 621-5(Sept. 1968).

A continuous-cooling transformation diagram was constructed for Ti–8Al–1Mo–1V alloy by using a Gluble controller and a high-speed dilatometer. Specimens were heated to 2400 or 2100°F and cooled to room temperature at various cooling rates ranging from 29 to 1125°F/sec. The $\beta \rightarrow \alpha$ transformation was found to be extremely rapid, even at the fastest cooling rates. The effects of cooling rate on microstructure, hardness, and phase content are discussed. It is suggested that a welding schedule with slow cooling rates below 170°F/sec will improve ductility of the weld heat-affected zones. (D.L.C.)

47688 INTERPLANAR ANGLES AND STANDARD PROJECTIONS FOR BERYLLIUM. Govila, R. K. (Martin Marietta Corp., Baltimore). J. Less-Common Metals, 16: 166-70(Oct. 1968).

The interplanar angles in the hcp lattice of Be (c/a = 1.568) were calculated and are tabulated for 0001, $10\bar{1}0$, $10\bar{1}1$, $10\bar{1}2$, $11\bar{2}0$, and $21\bar{3}0$ planes. Standard projections of the (0001) basal plane and $(10\bar{1}0)$ prism plane are given. (D.L.C.)

47689 INDEXING OF DIFFRACTION PATTERNS AND BURGERS VECTOR ANALYSIS IN HEXAGONAL CLOSE-PACKED STRUCTURES. Levien, E. (Rutgers - The State Univ., New Brunswick, N. J.). J. Less-Common Metals, 16: 157-61(Oct. 1968).

A combination of Kikuchi mapping and stereographic projection techniques are used to rapidly index electron diffraction patterns and to select reflection planes for Burgers vector determinations. The method is applied to hexagonal Be and dislocations therein. (D.L.C.)

47690 EFFECT OF COOLING RATE ON THE $\beta-\alpha$ TRANSFORMATION IN THE ZIRCONIUM/2 AT. % CHROMIUM/0.16 AT. % IRON ALLOY. Slattery, G. F. (United Kingdom Atomic Energy Authority, Lancs, Eng.). J. Less-Common Metals, 16: 91-101(Oct. 1968).

The $\beta-\alpha$ transformation in the zirconium–2 at. % chromium–0.16 at. % iron alloy shows two distinct temperature plateaus. The higher plateau at 760°C is likely to be non-martensitic, while the lower plateau at 705°C is probably martensitic and represents the true Ms temperature for this alloy. The separation between the two transformations is in the region of 1700°C/sec cooling rate and beyond this critical cooling rate, the Ms temperature is independent of cooling rate up to 4500°C/sec. Quench hardening takes place and an increase of 130 VHN units is obtained with increase in cooling rate. The microstructures varied with cooling rate. At intermediate cooling rates, the structure consisted of a coarse Widmanstätten product which changed to a fine, acicular product with increase in cooling rate. The intermetallic phase, presumably $ZrCr_2$ associated with a very low iron concentration, acted as a nucleus for the shear needles of α'. There were no surface rumpling effects due to quenching out the martensitic structure but this may be explained by a shape change for the hcp–bcc transformation which involves only small, or adjacent and opposite displacements. (auth)

Radiation Effects

Refer also to abstracts 47660 and 47671.

47691 EFFECTS OF FAST NEUTRON IRRADIATION ON A Fe–Si 6,5 PERCENT ALLOY WITH ZERO MAGNETOSTRICTION. Ferro, A.; Montalenti, G.; Soardo, G. P. (Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin). Energ. Nucl. (Milan), 15: 602-7(Sept. 1968).

A zero magnetostriction Fe–Si 6.5% alloy was irradiated with 10^{18} n/cm^2 (E > 1 MeV). It is shown that the comparison between the magnetic viscosity effects induced by the irradiation in pure iron and in a zero magnetostriction alloy permits descrimination between a model of anisotropic point defects, and a model of small clusters of point defects. Magnetic viscosity effects in Fe–Si 6.5% after irradiation are found to be very similar to the ones of pure iron (viscosity formation between 30 and 100°C, recovery above 100°C, activation energy of the order of 1 eV, maximum intensity of the order of 0.7 A/m), though characterized by some differences in the time constant spectrum, justified by the lower diffusion rate of the radiation defects due to the presence of silicon. The similarity between the magnetic effects in pure iron and in the zero magnetostriction alloy, permits one to identify the radiation defects as point anisotropic defects, such as divacancies or tri- or tetra-vacancy clusters. The influence of vacancy-impurity pairs is also examined. (auth)

47692 IRRADIATION EFFECTS IN 2103/R3 STEEL. COMPARISON BETWEEN DIFFERENT HEATS AND DIFFERENT FABRICATION PROCEDURES. Grounes, M. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Appl., 5: 228-35(1968).

The susceptibility to irradiation effects in different heats of the same steel and in parts of a reactor vessel that had gone through different stages in the manufacturing process was investigated. Fourteen sets of miniature impact specimens of Uddeholm UHB 2103/R3 steel, the pressure vessel material of the Ågesta reactor, were irradiated at 235 ± 15°C to a neutron fluence of 4×10^{18} to 10^{19} n/cm^2 (>1 MeV). The results indicate that there might be a difference by a factor of two in irradiation-induced transition temperature increases between materials from different parts of the vessel. Generally, changes in the hot-pressed material seemed to be larger. If irradiation-damage studies are performed on flat, normalized plate the results are valid if an extra safety margin of 30°C is applied. (auth)

Ceramics and Cermets

Corrosion and Erosion

47693 OXIDATION OF UO_2 BY OXYGEN AT 66°C AND 80°C. Dominey, D. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 30: 1757-60(Aug. 1968).

The increase in weight of uranium dioxide with time in the presence of 6 to 7 torr of oxygen at 66 and 80°C was measured with a recording microbalance. At 80°C the composition of the uranium oxide was $UO_{2.33}$ after 2650 hr. At 66°C the composition reached $UO_{2.28}$ after 7400 hr. The kinetics of oxidation were described approximately by an equation for diffusion of O atoms into UO_2 spheres with diffusion coefficients of 4×10^{-19} cm^2/sec at 66°C and 1.5×10^{-18} cm^2/sec at 80°C. The coefficients are close to the values obtained by extrapolation from published data. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 47110 and 47667.

47694 BERKELIUM OXIDE SYSTEM. Baybarz, R. D. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. J. Inorg. Nucl. Chem., 30: 1769-73(Aug. 1968). (ORNL-P-3325).

The oxides of berkelium were prepared by loading 1 μg of carefully purified ^{249}Bk on to single beads of ion exchange resin and calcining the resin beads to remove organic material and to yield the oxides. Air firing gave BkO_2, which had a fcc lattice with a = 5.334 ± 0.005 Å. Hydrogen reduction of BkO_2 gave the bcc Bk_2O_3 with a = 10.880 ± 0.005 Å. (auth) (UK)

47695 ENTHALPY OF FORMATION OF CERIUM SESQUIOXIDE. Baker, Floyd B.; Holley, Charles E. Jr. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Chem. Eng. Data, 13: 405-7(July 1968). (LA-DC-9144).

Oxygen-bomb calorimetry was used to determine the energy of combustion of Ce_2O_3. The enthalpy change for the reaction Ce_2O_3-hexagonal + $\frac{1}{2}O_2$ = $2CeO_2$ was $\Delta H^0_{298.15°K}$ = −91.05 ± 0.16 kcal which leads to a value for the enthalpy of formation of Ce_2O_3 of $\Delta H^0_{f\,298.15°K}$ = −429.31 ± 0.68 kcal per mole. (auth)

47696 PREPARATION AND PROPERTIES OF MEAN DYSPROSIUM AND HOLMIUM TUNGSTATES. Amosov, V. M.; Plyushchev, V. E. Zh. Prikl. Khim., 41: 1637-43(Aug. 1968). (In Russian).

Optimum conditions for preparation of dysprosium and holmium tungstates were found at high-temperature (900°C) sintering of Dy_2O_3 or Ho_2O_3 with WO_3 in air for 8 hr. (tr-auth)

47697 CERAMICS TODAY. Burke, Joseph E. (General Electric Research and Development Center, Schenectady, N. Y.). Science, 161: 1205-12(Sept. 20, 1968).

Some examples are given of new ceramic materials and of the ability to control the properties of these materials. Topics covered include: relation to physical metallurgy, important uses of ceramics, atomic transport in ceramics, solid-state diffusion, ionic conductivity, sintering, grain growth, breakaway of a pore from a grain boundary, and future trends. (M.C.G.)

47698 SOL-GEL PROCESS FOR THE PREPARATION OF NUCLEAR FUEL. Komac, Milos; Kolar, Drago. Nukl. Energ., 5: 5-8(1968). (In Slovak).

Procedures for preparation of ThO_2 and UO_2 microspheres are described. The peptization method is used for preparation of the sols. A well controlled denitration process is required. The preparation of UO_2 sol must be accomplished in a protective atmosphere. A careful control of pH and concentrations of all ions in the solution is important to the stability of the colloidal solutions. The stable sols were transformed into gels by several methods, the simplest requiring only a careful dispersion of the sol in proper organic phase. However, this method was used successfully only for the preparation of the smallest microspheres, 50 to 150 μ. The size distribution of the spheres covered a broader range and was partially controlled by the speed of agitation. The continuous method with column was also investigated, using the two-fluid nozzle and rotary disperser. The first method required a uniform organic phase flow and sol flow, and produced droplets of uniform size. The last method gave the best results, the main parameter to be controlled was the speed of the rotary disperser. After careful drying and low temperature sintering, uniform, high density UO_2 and ThO_2 microspheres were obtained. (auth)

47699 BERYLLIUM BASE CERMETS. I. PREPARATION AND MECHANICAL AND THERMOPHYSICAL PROPERTIES. Ivanov, V. E.; Zelenskii, V. F.; Zhdanov, S. M.; Faifer, S. I.; Khorenko, V. K.; Matvienko, B. V.; Savchenko, V. I. Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 33-6(July 1968). (In Russian).

Mechanical and thermophysical properties of metal–ceramic compact Be–BeO specimens prepared by hot compression in a vacuum at 1150 to 2000°C and 50 to 120 kg/cm^2 pressure were analyzed. (R.V.J.)

47700 SINTERING AND RECRYSTALLIZATION OF PRESSED PARTS BASED ON ZrC–ZrB_2. Gropyanov, V. M.; Bel'tyukova, L. M. (Leningrad Inst. of Refractory Materials). Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 25-32(July 1968). (In Russian).

Sintering of ZrC and ZrB_2 and pressed parts on their base improves with the increase of the specific area of the initial powders. The introduction of the second component into ZrB_2 or ZrC makes the sintered parts more compact, other conditions being equal. The grain size reaches its maximum in ZrC; it is less in ZrB_2 and still less in the pressed parts. Speed constants of grain growth and activation energy of the process of collective recrystallization decrease in the same succession. It is shown that the limiting grain size l_∞ is constant in the isothermal conditions. The grain size l approximates to l_∞ when $\tau \to \infty$. (auth)

Properties Evaluations

Refer also to abstracts 47302, 47675, 47697, and 47699.

47701 (AI-AEC-12726) SELF-DIFFUSION OF URANIUM AND CARBON IN URANIUM MONOCARBIDE. Bentle, G. G.; Ervin, G. Jr. (Atomics International, Canoga Park, Calif.). Aug. 30, 1968. Contract AT(04-3)-701. 21p. Dep. CFSTI.

Diffusion coefficients of carbon and uranium in uranium carbide 4.4 to 4.9 wt % C were measured by tracer and sectioning techniques on specimens annealed at 1100 to 2000°C. Carbon diffusion was faster than uranium diffusion by two or three orders of magnitude. There was a small dependence on composition; higher carbon caused some increase in carbon diffusion and a decrease in uranium diffusion. The specimens varied in grain size but no significant differences were found between the coarse-grained and fine-grained specimens. Breaks occurred in the Arrhenius curves at about 1500°C; the lower activation energies below 1500°C were attributed to short-circuiting by grain boundary or sub-grain boundary transport in the low-temperature region. Five studies of self-diffusion in UC are reviewed and compared with the present results. (auth)

47702 (BAW-3809-3) POST-IRRADIATION EXAMINATION OF THORIA–URANIA FUEL RODS. Quarterly Progress Report No. 3, December 1967–February 1968. Bishop, W. N.; Baroch, C. J. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). July 1968. Contract AT(30-1)-3809. 16p. Dep. CFSTI.

The dissolution of thoria–urania fuel was studied, and it was shown that 13 M nitric acid–0.05 M fluoride under reflux was effective for both irradiated and unirradiated material. Nondestructive examination of the fuel rods showed that they were in excellent condition, and in some cases pellets were intact and free to move within the rods. Eight of the 13 rods have been sectioned, and chemical and metallurgical examinations are in progress. (auth)

47703 (BMI-X-10210) FABRICATION, CHARACTERIZATION, AND THERMAL-PROPERTY MEASUREMENTS OF ThO_2–UO_2 FUEL MATERIALS (LWBR DEVELOPMENT PROGRAM). Springer, J. R.; Eldridge, E. A.; Goodyear, M. U.; Wright, T. R.; Lagedrost, J. F. (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1967. Contracts W-7405-eng-92; AT(11-1)-Gen-14; Subcontract 73-14-1202. 146p. Dep. CFSTI.

For Bettis Atomic Power Lab., Pittsburgh, Pa.

Thermophysical-property specimens of ThO_2, ThO_2–10 wt % UO_2, and ThO_2–20 wt % UO_2 were fabricated and characterized. Each material composition was represented by specimens with nominal densities of 95, 85, and 75 percent of theoretical. Thermal-diffusivity, linear-thermal-expansion, and specific-heat measurements were made at 300 to 1900°C and used to determine thermal conductivity. Results of linear-thermal-expansion and specific-heat measurements were approximately the same for all materials. Values of linear thermal expansion ranged up to 2.2 percent in heating from room temperature to 2000°C. The specific heat ranged from 0.055 cal/(g) (C) at 0°C to 0.080 cal/(g) (C) at 2000°C. Thermal-diffusivity values ranged from 3.0×10^{-2} cm^2 per sec at 300°C to 0.5×10^{-2} cm^2 per sec at 1900°C. Thermal conductivities decreased in regular fashion with increased UO_2 content and porosity. An equation is given which fits all of the data obtained; it is anticipated that it will fit the data for other compositions within the given limits. (auth)

47704 PROPERTIES OF PLASMA-SPRAYED BORIDES AND NITRIDES. Lecrivain, L.; Provost, G. (Societe Francaise de Ceramique, Paris). Ber. Deut. Keram. Ges., 45: 347-51(July 1968). (In German).

Properties investigated include chemical and crystallographic composition, bulk density, mechanical strength, Young's modulus, thermal conductivity, microhardness, thermal expansion, and resistance to oxidation. There is generally a clear difference between the properties of materials produced by spraying and by sintering. Other points studied include changes of different properties as functions of temperature; particular attention was paid to the decrease of stresses arising during spraying. The plasticity of these materials at low temperatures was also investigated. The experiments show that further developments may be expected from special spraying and finishing techniques. (auth)

47705 MAGNETIC SUSCEPTIBILITY OF MONOCARBIDES OF Zr, Hf, AND Nb. Samsonov, G. V.; Kuchma, A. Ya. (Inst. of Problems in Materials Management, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1361-3(Aug. 1968). (In Russian).

The magnetic susceptibility of ZrC, HfC, and NbC was studied as a function of the C content. Tabulated data on chemical composition, lattice period magnitude, and specific magnetic susceptibility in the homogeneous regions of ZrC, HfC, and NbC specimens are analyzed. (R.V.J.)

47706 THERMAL EXPANSION OF ZrC–NbC SOLID SOLUTIONS. Barantseva, I. G.; Paderno, V. N. (Inst. of Problems in Materials Management, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1364-5(Aug. 1968). (In Russian).

The thermal expansion of solid solutions of ZrC–NbC and Hf–TaC isothermal and isostructural systems were studied in the temperature range from 300 to 1300°C. (R.V.J.)

47707 INVESTIGATION OF DIAMOND AND GRAPHITE WETTING WITH MELTED METALS AND ALLOYS. VII. EFFECT OF VANADIUM, NIOBIUM, MANGANESE, MOLYBDENUM, AND TUNGSTEN ADDITIVES ON GRAPHITE WETTING WITH ALLOYS ON THE COPPER BASE. Naidich, Yu. V.; Kolesnichenko, G. A. Porosh. Met., Akad. Nauk Ukr. SSR, No. 7, 71-5(July 1968). (In Russian).

Experimental material is presented on the wetting of graphite with copper-base alloys with additives of some transient metals. The data permit one to judge on the concentration and temperature dependence of wetting boundary angles. (auth)

Structure and Phase Studies

47708 CRYSTAL STRUCTURE OF COPPER URANIUM TETROXIDE. Siegel, Stanley; Hoekstra, Henry R. (Argonne National Lab., Ill.). Acta Crystallogr., Sect. B, 24: 967-70 (1968).

Copper monouranate crystallizes in the monoclinic system with $a = 5.475 \pm 0.006$, $b = 4.957 \pm 0.006$, $c = 6.569 \pm 0.006$ Å and $\beta = 118.87 \pm 0.15°$. The space group is $P2_1/n$ with two formula weights in the cell. The uranium–oxygen configuration is characterized by short collinear uranyl bonds, each of length 1.90 Å, nearly normal to a planar and almost square array of secondary uranium–oxygen bonds of lengths 2.15 and 2.24 Å. Two uranyl and two secondary oxygen atoms form a square planar configuration about each copper atom with copper–oxygen bond lengths of 1.95 and 1.96 Å. Two very long copper–oxygen bonds, of lengths 2.59 Å each are observed above and below the copper–oxygen plane. All bond distances are consistent with bond strength values. (auth) (Denmark)

47709 KARBIDY. (Carbides). Kosolapova, T. Ya. Moscow, Izdatel'stvo Metallurgiya, 1968. 300p.

Data are presented on the structure, physicochemical properties, preparation, and applications of carbide–metal systems. Constitution and phase diagrams are given for actinide, scandium, yttrium and lanthanide groups of carbides and for metal carbides of the IV, V, VI, and VIII subgroups in periodic tables. (921 references are included.) (R.V.J.)

47710 METAL–METAL BONDING IN $La_4Re_6O_{19}$ AND RUTILE-RELATED DIOXIDES. Sleight, T. P. (State Univ. of New York, Buffalo); Hare, C. R.; Sleight, A. W. Mater. Res. Bull., 3: 437-44(May 1968).

Extended Huckel calculations have been used to rationalize the existence of a Re–Re double bond across the edge-shared octahedra in $La_4Re_6O_{19}$. By analogy, double bonds are probably also present in the distorted rutiles: MoO_2, WO_2, and α-ReO_2. Quantitative energy diagrams are not given, but it is shown qualitatively

that the molecular levels of primarily metal-metal bonding character are very sensitive to the separation of the bridging oxygens, as well as to the metal-metal distance. (auth)

47711 CRYSTALLOGRAPHIC AND MAGNETIC STUDY OF RARE EARTH DOUBLE OXIDES OF THE TYPE $LaTO_3$; T = Ho, Y, Er, Tm, Yb, Lu. Moreau, Jean Michel (Centre d'Etudes Nucleaires, Grenoble, France). Mater. Res. Bull., 3: 427-31 (May 1968). (In French).

A summary is given of crystalline structure and magnetic properties of rare earth double oxides of the perovskite type $LaTO_3$, where T may be Ho, Y, Er, Tm, Yb, or Lu. (tr-auth)

47712 BAND MODEL FOR TRANSITION-METAL CHALCOGENIDES HAVING LAYER STRUCTURES WITH OCCUPIED TRIGONAL-BIPYRAMIDAL SITES. Goodenough, John B. (Massachusetts Inst. of Tech., Lexington). Mater. Res. Bull., 3: 409-15 (May 1968).

From symmetry arguments, the occupied d bands of superconducting $NbSe_2$ and semiconducting WSe_2 are identified as $|\pm 2, \mp \frac{1}{2}\rangle$, which is split from the next higher d band $|\pm 2, \pm \frac{1}{2}\rangle$ by the energy gap $E_g = 2k_c\lambda - W_b$. W_b is the mean bandwidth and $k_c\lambda$ the effective spin-orbit coupling parameter. (auth)

47713 ANb_2O_6 AND ATa_2O_6 PHASES. Galasso, F.; Layden, G.; Ganung, G. (United Aircraft Research Labs., East Hartford, Conn.). Mater. Res. Bull., 3: 397-407(May 1968).

Crystals of the high temperature form of $BaNb_2O_6$ were grown from a BaB_2O_4 flux. The symmetry of the crystals is orthorhombic and the structure consists of a zigzag pattern of edge-sharing pairs of NbO_6-octahedra joined at corners at nearly 60° and 120° angles to produce rings of six octahedra. The barium atoms are situated in the cages formed by the rings. A comparison is made with the structures of other ANb_2O_6 and ATa_2O_6 type phases where A is Ba, Sr or Ca. (auth)

47714 MELTING DIAGRAM OF Eu AND Cr OXIDES. Portnoi, K. I.; Mordovin, O. A.; Timofeeva, N. I. Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1368-70(Aug. 1968). (In Russian).

The constitution diagram of $Eu_2O_3-Cr_2O_3$ system was constructed. It showed that the system consists of one chemical compound melting congruently, with the europium oxide melting point at 2220 ± 50°C and chromium oxide at 2290 ± 50°C. Tabulated data are given of the chemical composition of melted specimens and the properties of europium oxide and europium chromite. (R.V.J.)

47715 DETERMINATION OF THE ZIRCONIA–HAFNIA PHASE DIAGRAM. Ruh, Robert; Garrett, Harold J. Res. Rev. (Office Aerosp. Res.), 7: No. 5, 7-8(May 1968).

The ZrO_2-HfO_2 system was studied at 600°C to liquidus temperatures, using metallographic, x-ray diffraction, and electron-probe analyses. The results show complete solid solubility. The monoclinic–tetragonal inversion was investigated by differential thermal and high-temperature x-ray analyses and founded to exhibit a continuous increase as the composition moves from ZrO_2 to HfO_2. A phase diagram is presented. (D.L.C.)

Radiation Effects

Refer also to abstract 48644.

47716 PARTIALLY ANNEALED INTERSTITIAL MATERIAL IN NEUTRON BOMBARDED GRAPHITE. Robson, D.; Harker, H. (Univ. of Newcastle upon Tyne, Eng.). Nature (London), 219: 930-1(Aug. 31, 1968).

It was found that a moderator graphite irradiated in CO_2 to 25.7×10^{19} n/cm^2 at 220°C took up Br_2 very freely, in contradistinction to the reported inhibition of bromine lamellar compound formation even by very slight neutron bombardment. This was first discovered in the course of ESR experiments, and subsequently demonstrated gravimetrically. X-ray diffraction photographs clearly indicated lamellar compound formation. The result, however, was not typical, since for several other cases the ESR signal of the irradiated material was virtually unaffected by exposure to Br_2, and the amount of halogen taken up was very small. It was concluded that the differences in behavior were connected with the atmosphere present during the neutron bombardment, Br_2 being readily taken up by specimens irradiated in CO_2 but not by those irradiated in vacuum. Results indicated that Hennig's interpretation of the inhibition of the lamellar reaction as being due to steric hindrance by unannealed interstitial material is incorrect, since X-ray diffraction confirmed that considerable numbers of unannealed interstitials are present in specimens irradiated in CO_2, which will very readily take up Br_2. It is conceivable, however, that unannealed interstitials might be indirectly responsible for the absence of a lamellar reaction in vacuum-irradiated graphite by producing closure of pores; but recovery of properties on annealing will presumably be accompanied by pore volume recovery and Br_2 uptake. The latter, however, does not occur. Electron microscope studies have suggested that Br_2 normally gains access to the graphite structure by means of dislocations, and this has been demonstrated by ESR. There is also considerable evidence that dislocations can act as sinks for interstitial complexes. It is suggested that a fraction of the interstitial species, while not re-integrating completely with the structure, undergoes a process of partial annealing at the dislocations, losing unpaired electrons in the process. As a result, adjacent layer planes may be pinned together or cross-linked by strong bonds, so that the interlayer spacing cannot be increased to that necessary to accommodate Br_2 molecules. The ready uptake of Br_2 by specimens irradiated in CO_2 is attributed to continuous removal of the partially annealed interstitial groups by radiolytic oxidation. The implication that trapped interstitial material is more reactive than the main carbon structure may be of relevance to the chemical behavior of graphite, both in-pile and out-of-pile. The existence of partially annealed interstitial material may also be of relevance to physical property changes produced by neutron bombardment. Some comparisons are made with uptake of potassium. (UK)

Plastics and Other Materials

Refer to abstracts 48650 and 48736.

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstracts 47795, 47841, 47842, 47848, 47851, 47892, 48369.

47717 (CEA-BIB-121) SOLAR PHYSICS. Berthier, Daniel (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). June 1968. 36p. (In French). Dep.

The essential theories put forward nowadays of the solar mechanism are discussed. The transfer of the energy from the central nucleus where it is produced up to the most external zones is discussed. In the nucleus, characterized by high densities and high temperatures, thermonuclear reactions are produced where hydrogen is transformed into helium. (auth)

47718 (N-68-23316) COMPUTER SIMULATION OF THE EVOLUTION OF SPIRAL GALAXIES. Hohl, Frank (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Apr. 4, 1968. 33p. (CONF-680447-1; NASA-TM-X-61081). CFSTI.

From 126th Meeting of American Astronomical Society, Charlottesville, Va.

A two dimensional model was used to perform computer experiments for a collisionless self-gravitating system. The gravitational field was obtained by solving the Poisson equation and the system was advanced stepwise in time. Computer simulations were performed for systems with an initially uniform distribution over a circular or elliptical region in x-y space, zero thermal velocity, and with given values of initial solid-body rotation. Up to 10,000 stars were used in the calculations. As such systems evolve in time they display the various shapes observed in actual galaxies. It was found that some of the calculations recently reported cannot be considered collisionless. (auth) (STAR)

47719 (N-68-23445) PENETRATION OF SOLAR PROTONS TO FOUR EARTH RADII IN THE EQUATORIAL PLANE. Fillius, R. Walker (California Univ., La Jolla, San Diego. Dept. of Physics). Mar. 1968. Contract NAS5-3063. 67p. (CONF-671060-2; NASA-CR-94569; UCSD-SP-68-3). CFSTI.

From IAGA Special Events Symposium, St. Gall, Switzerland.

Solar protons in the 40- to several-hundred-MeV range were monitored by Explorer 26 at low L values inside the boundary of trapped radiation near the geomagnetic equator on February 5, 1965, and on March 24, July 7, August 28, and September 2, 1966. The spatial distribution was characterized by a plateau of constant intensity, bordered by a region of east-west symmetry below the particle cutoffs of some directions of arrival, and terminated by the final cutoffs for eastbound particles. The cutoffs are below their classical Stoermer values, but they are empirically described by a modified Stoermer theory. The cutoff altitudes are lowered during the magnetic storm, and the limited sample correlates better with K_p than with D_{st}. It can be shown that a symmetrical ring current is expected to raise the equatorial cutoffs, so that some other mechanism is needed to account for the storm effect. The geomagnetic tail may account for this mechanism. The particles seen in these events show no evidence for merging with the trapped radiation and becoming permanently trapped. (auth) (STAR)

47720 ALUMINUM HYDRIDE EMISSION LINES IN χ CYGNI NEAR MINIMUM LIGHT. Herbig, G. H.; Zappala, R. R. (Univ. of California, Santa Cruz). Z. Astrophys., 68: 423-30(1968).

Emission lines of the $A^1\Pi - X^1\Sigma^+$ system of Al H appear with considerable intensity in the long-period variable χ Cyg near minimum light. Only fragments of branches of the 0-0, 1-0, and 1-1 bands are observed, because only a limited number of upper rotational states are populated by the process of inverse predissociation which forms Al H molecules from free atoms under these conditions. The relative probability of formation of molecules in the various J' levels of $v' = 0$ and 1 is obtained from emission equivalent widths measured in χ Cyg. The suppression of the 0-1 band of Al H indicates that the emitting layer lies below the region in which TiO and ZrO absorption takes place. (auth)

47721 NEW PERTURBATION METHOD FOR NON-SPHERICAL STARS. Monaghan, J. J. (Univ. of California, Santa Cruz). Z. Astrophys., 68: 461-72(1968).

A new method of calculating the structure of nonspherical stars is proposed which determines as a first approximation a spherical configuration which closely approximates the mass and luminosity or kinetic energy and angular momentum of the real star. This model is then used as a first term in a perturbation series. The construction of the initial model proceeds by determining a radial force from the real, nonspherical force in such a way that they both give rise to the same moments when integrated over the volume of the star. The method is of great generality and can be applied when rotation, magnetic fields, or tidal forces produce the distortion. Calculations are described for rapidly rotating polytropes. (auth)

47722 NATURE OF THE OPTICAL CONTINUUM OF QUASI-STELLAR OBJECTS. Grewing, Michael; Lamla, Erich (Univ., Bonn). Z. Astrophys., 68: 473-85(1968).

From selected spectrophotometric tracings the mean optical continuum of quasi-stellar objects was determined between 1000 to 7000 Å. This continuum does no longer follow a simple power-law but can be fitted by either an exponential spectrum with a critical frequency $\nu_0 = 1.5 \times 10^{15}$ Hz, or by a two-component model with one component being thermal while the other is nonthermal and follows a power-law spectrum with an index $n \approx 0.7$. Two observational tests are discussed that could serve to decide what physical processes are responsible for the optical radiation of quasi-stellar objects. New values for the K correction are given for UBV and RI. (auth)

47723 ELECTRONS MAGNETIC FIELDS AND BACKGROUND RADIO EMISSION IN THE GALAXY. Anand, K. C.; Daniel, R. R.; Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 67: 267-83(May 1968).

Extensive data now available on the nonthermal background radio emission from different celestial directions, and recent measurements on the energy spectrum of cosmic-ray electrons in the vicinity of the Earth permit one to deduce information on the mean magnetic fields and cosmic electron spectra needed to exist in different regions of the Galaxy. It is found that in order to explain quantitatively the background radio brightness distributions from the Galaxy one needs (i) the same or nearly same electron spectrum that exists in near stellar space, to exist in almost all regions of galactic space, (ii) a mean magnetic field close to 6×10^{-6} gauss in the disc in the direction of the anticenter, (iii) a mean magnetic field close to 2.5×10^{-6} gauss in the radio halo, and (iv) a mean magnetic field probably close to 9.5×10^{-6} gauss towards the galactic ridge in the direction of the center. Some inferences are also drawn on the confinement of cosmic rays in the Galaxy. (auth)

47724 PRINCIPLES OF STELLAR EVOLUTION AND NUCLEOSYNTHESIS. Clayton, Donald D. New York, McGraw-Hill Book Company, 1968. 621p. $22.50.

This book, which is intended for a graduate level course, has a strong orientation toward nuclear physics. Areas covered include physical introduction to the stars, thermodynamic state of the stellar interior, energy transport in the stellar interior, thermonuclear reaction rates, major nuclear burning stages in stellar evolution, calculation of stellar structure, and synthesis of the heavy elements. (W.D.M.)

47725 ELEMENTARY MODELS FOR STIMULATED RADIO EMISSION FROM INTERSTELLAR OH. Cook, A. H. (National Physical Lab., Teddington, Eng.). Mon. Notic.Roy. Astron. Soc., 140: 299-318(1968).

The aim was to explore, on a phenomenological basis, some implications of the hypothesis that the 18-cm radiation from interstellar OH arises from stimulated emission. In order to have a reasonably well-defined model, it is supposed that the radiating gas lies in the ionization front around an H II region and that stimulated emission occurs only from narrow columns with well-defined gas velocities. The total radio power from an H II region is estimated on a statistical basis and compared with the power radiated by an O or B star at the center of the region. Estimates are also made of the characteristic length of a radiating column, of the gain of the equivalent stimulated emission amplifier, and of the necessary population inversion. In order to ascertain if the observed peculiar intensity ratios and time variations can be accounted for by stimulated emission, the coupled nonlinear equations for radiation transfer and for the population ratios are formulated and studied in a preliminary way. It is shown that for a wide range of assumptions about the molecular processes involved in inverting the population, the observations cannot be accounted for if the stimulated terms are ignored in comparison with the spontaneous terms in the rate equations. If the stimulated terms are retained (as seems in fact justified by the intensity of the radiation) the coupling between the two sets of equations may lead to intensity ratios such as are observed. The implications of these results for the molecular physics and for the structure of H II regions are indicated. (auth) (UK)

47726 IMPROVED FRIEDMANN MODELS. Harrison, E. R. (Univ. of Massachusetts, Amherst). Mon. Notic. Roy. Astron. Soc., 140: 281-5(1968).

The improvement of the Friedmann models of the Universe with the inclusion of non-interacting radiation was first made by Lemaitre in 1927. These "improved Friedmann models" are discussed and it is shown that they require modification in the early Universe because of pair production at high temperatures. (auth)

47727 INTERSTELLAR GAS DYNAMICS AND THE MOTIONS OF YOUNG STARS. Dixon, M. E. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc., 140: 287-97(1968).

Recent investigations have indicated that the interstellar gases orbit under the influence of nongravitational as well as gravitational forces. The investigations lead to the tentative conclusion: stars are formed near apogalacticon. The investigation described in the present paper was designed to test this conclusion. The investigation was made by tracing some of the nearer A-type stars back to their places of origin in the Galaxy. The results of the investigation support the conclusion. The results indicate that the vast majority of young stars, in the solar region, were formed near apogalacticon. (auth) (UK)

47728 THE COLLAPSE OF INTERSTELLAR GAS CLOUDS. II. AN ANALYTICAL STUDY. Disney, M. J.; McNally, D.; Wright, A. E. (London Univ.). Mon. Notic. Roy. Astron. Soc., 140: 319-30(1968).

The equations of hydrodynamics with gravitation are derived in an Eulerian form suitable for direct use in numerical methods. This form of equations is particularly well suited for a simple derivation of analytical solutions for the case of linear wave flow. Linear wave flow solutions are obtained with a view to their subsequent use as checks of the numerical studies. It is shown that integral checks of the motion can ascribe a misleading accuracy to the numerical methods—in particular an integral check may show that an error of less than 0.1% is to be expected, whereas a comparison with an analytical solution showed the existence of errors of about 100% in the parameters of the solution near the center of the gas cloud. (auth) (UK)

47729 JEANS CRITERION IN RELATIVISTIC COSMOLOGY. Arons, Jonathan; Silk, Joseph (Harvard Coll. Observatory, Cambridge, Mass.). Mon. Notic. Roy. Astron. Soc., 140: 331-9(1968).

The problem of gravitational instability in an expanding universe is studied. A physically meaningful discussion is given by using as a coordinate condition the generalized de Donder gauge condition. This technique allows the general relativistic discussion to be exactly analogous to the Newtonian treatment of Bonner (1957), and an explicit Jeans criterion may consequently be obtained. An unexpected result is found for an isothermal model universe: damping of fluctuations of any given scale occurs after sufficient time has elapsed. Approximate analytic and exact numerical solutions of the perturbation equations are presented. (auth) (UK)

47730 SPECTRAL ANALYSIS OF THE MANGANESE STAR HD 1909. Buscombe, W.; Chambliss, C. R.; Kennedy, P. M. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc., 140: 369-85(1968).

A spectrogram of high dispersion reveals very many unusually sharp absorption lines of ionized metals in the atmosphere of the B_9 star HD 1909. Since this is a fairly typical example of a manganese star, the line strengths were analysed differentially with respect to those for the star 53 Tauri. HD 1909 is substantially richer in iron, gallium, yttrium, and zirconium, but weaker in helium and chromium, than 53 Tauri. A strong line at λ3984 is attributed to ionized mercury, but no lines of phosphorus or rare-earth elements are seen. (auth) (UK)

47731 EVOLUTION OF PARTIALLY DEGENERATE HELIUM CORES. Eggleton, Peter P. (Univ. of Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc., 140: 387-402(1968).

Computations were carried out on partially degenerate helium cores of red giants, evolving them from an initially isothermal state to a state where the temperature at some point is sufficiently high for helium to burn. Evolution to the helium flash was computed for various zero-age compositions (X = 0.65, 0.9; Z = 0.01, 0.001, 0.0001), and the effect of different values for opacity and neutrino losses was considered. The possibility of nitrogen burning by α-particles was not included. This is reasonable for the two lower values of Z. It is found that for stars on the verge of the helium flash $\log (L_{bol}/L_\odot)$ is in the range 3.38 ± 0.1 for all the above compositions. Although increasing the zero-age helium content from 0.1 to 0.35 decreases slightly the luminosity at the flash, the decrease appears to be too slight for use as a criterion of the zero-age helium abundance in globular clusters. A preliminary examination of the seven globular cluster diagrams of Arp (1955), using the somewhat uncertain bolometric corrections for late giants, suggests that for the brightest star on each giant branch $\log (L_{bol}/L_\odot) \sim 3.4 \pm 0.2$. (auth) (UK)

47732 THE IDENTITY OF LAGRANGE AND JACOBI FOR A STELLAR SYSTEM FORMED OF STARS AND DIFFUSE MATERIAL. Bouvier, Pierre (Observatoire de Geneva). Arch. Sci. (Geneva), 20: 415-24(Sept.-Dec. 1967). (In French).

The Lagrange and Jacobi identities are written for an inviscid and perfectly conducting gaseous configuration with stars. The upper threshold value of the magnetic field for stability increases. Equilibrium configurations are described, and equations for the stability of a cylindrical configuration are derived. The conditions for applying these results to the stability of a galactic arm are discussed. The critical value for the cylindrical gas is only a third of that obtained including stars in the arm. Orientation of dust perhaps exerts a field of the same magnitude. Difficulties with the cylindrical-gas model are pointed up by its neglect of effects occurring at different stages of stellar genesis. Interaction with the field of the central galaxy is also noted. Further knowledge of relative movement of stars and diffuse matter is necessary to justify the assumption of equilibrium in the arm. (BBB)

47733 OBSERVATIONS OF 11 RADIO SOURCES NEAR 55 MHz. Haynes, R. F.; Hamilton, P. A.; McCulloch, P. M. (Univ. of Tasmania, Hobart). Aust. J. Phys., 21: 539-42(Aug. 1968).

In a program to study radio sources with curved spectra measurements were made on eleven southern hemisphere radio sources at the Australian NRAO. Observations were made at 54.2, 59.2, and 67.4 MHz. The observed spectra are given. (W.D.M.)

47734 ACCURATE POSITIONS AND SOME OPTICAL IDENTIFICATIONS FOR 67 RADIO SOURCES BETWEEN DECLINATIONS $+20^0$ AND $+27^0$. Merkelijn, Jeannette K.; Shimmins, A. J.; Bolton, J. G. (CSIRO, Epping, New South Wales). Aust. J. Phys., 21: 523-37(Aug. 1968).

Thirty-four identifications were made from a total of 67 radio sources for which accurate positions were measured with the 210-ft telescope. Nineteen of these are galaxies and 15 possible quasi-stellar objects. Only one of the identifications has been previously suggested. (auth)

47735 RADIO SOURCES IN CLUSTERS OF GALAXIES. Mills, B. Y.; Shobbrook, R. R.; Stewart-Richardson, D. (Univ. of Sydney). Aust. J. Phys., 21: 511-21(Aug. 1968).

Fifty-eight clusters from Abell's catalog were examined for radio emission using the Arecibo 1000-ft reflector and the Mologlo 1-mile Cross. The positions, sizes, and flux densities at 408 MHz of 30 radio sources close to these clusters were measured. Nineteen of these offer reasonable identifications with galaxies or blue stellar objects. Thirteen appear to be identifiable with individual cluster galaxies. No evidence for integrated cluster emission was obtained. It is concluded that either the centroid of radio sources may sometimes be well displaced from the parent galaxies or, in a significant number of cases, the only detectable radio source in a cluster is associated with a faint cluster galaxy, not a giant. (auth)

47736 NONLINEAR ADIABATIC PULSATIONS OF MASSIVE STARS. Murphy, J. O. (Monash Univ., Clayton, Victoria). Aust. J. Phys., 21: 465-73(Aug. 1968).

The pulsational properties of a sequence of massive stars were investigated. The second-order approximation to the equation of motion governing the adiabatic radial oscillations of these stars was determined allowing for the variation of the radiation pressure throughout the star. In each case the form of the radial velocity curve at the surface of the star was established taking into account the influence of higher modes of oscillation. (auth)

47737 DISTRIBUTION OF LINEAR POLARIZATION OVER 13 EXTENDED SOURCES AT 21.2 CM WAVELENGTH. Morris, D.; Whiteoak, J. B. (CSIRO, Epping, New South Wales). Aust. J. Phys., 21: 475-92(Aug. 1968).

The distribution of linear polarization over 13 bright radio sources was determined at 21 cm with an east–west interferometer. The results are presented in the form of strip brightness distributions of polarized flux and direction of polarization, with a resolution of 1′ by 20′. It is suggested that axial rotation during evolution contributes to the observed polarization features of extended radio sources. (auth)

47738 OPTICAL SPECTRUM OF VELA X. Milne, D. K. (Australian National Univ., Canberra). Aust. J. Phys., 21: 501-9(Aug. 1968).

The optical spectra of two filaments in the nebula Stromlo 16 (the radio source Vela X) were obtained with the photoelectric spectrum scanner. Electron temperature stratification over the filaments was deduced from the intensity ratios between certain lines in these spectra. Indications are of a small-sized high temperature region with an electron temperature $T_e \simeq 10^{5\circ}$K together with a much greater volume of cooler gas with $T_e \simeq 10^{4\circ}$K. The former region is bright in the lines of OIII while the latter region is bright in the lower excitation lines of O II, N II, and H. The collisionally excited nature of these spectra confirms previous conclusions that this object is the remnant of a supernova. (auth)

47739 OBSERVATIONS OF THE LINEAR POLARIZATION OF RADIO SOURCES AT 6 CM WAVELENGTH. Morris, D.; Whiteoak, J. B. (CSIRO, Epping, New South Wales). Aust. J. Phys., 21: 493-500(Aug. 1968).

The polarizations of 45 sources were measured at 6 cm wavelength and were compared with values obtained at longer wavelengths. The resulting wavelength dependence was studied in relation to the spectra of the sources. For the quasi-stellar objects in particular, polarization features at short wavelengths are associated with the young components of the source which radiate at high frequency. However, it is not possible to distinguish between radio galaxies and quasi-stellar objects solely on the basis of polarization data. (auth)

47740 NEUTRINOS FROM THE SUN. Salpeter, Edwin E. Comments Nucl. Particle Phys., 11: 97-102(July-Aug. 1968).

Neutrino emission from the sun is discussed in terms of the reaction processes involved, methods of detection, and measurements of the neutrino flux at the Earth. In particular, the experiment performed by Davis (Phys. Rev. Letters, 12: 302(1964)) is reviewed. (L.B.S.)

47741 A LARGE SOLAR FLARE OBSERVED IN JULY. Sky Telesc., 36: 190-1(Sept. 1968).

A brief description is given of a class-3 flare which occurred on July 8, 1968. The outburst took place in the eastern member of a pair of sunspots. (W.D.M.)

47742 LEAD–LEAD AGE OF THE BONDOC METEORITE. Marshall, Royal R. (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta, 32: 1013-18(Sept. 1968).

The concentration of lead in a portion of the Bondoc meteorite was determined by the isotopic dilution technique to be 0.071 ± 0.005 ppM. Isotopic ratios of the lead in the meteorite were found to be $^{208}Pb/^{204}Pb = 20.11$, $^{207}Pb/^{204}Pb = 18.53$, and $^{208}Pb/^{204}Pb = 39.12$. The $^{207}Pb/^{204}Pb$ ratio is quite high relative to the $^{206}Pb/^{204}Pb$ ratio, indicating a possible lead–lead age of 4.94×10^9 years. This calculation is based on the assumption that the present $^{238}U/^{235}U$ ratio in this meteorite is 137.7. (auth) (UK)

47743 RADIOACTIVITY INDUCED BY COSMIC RAYS IN THE GRANES METEORITE. Mabuchi, H.; Tobailem, J.; Leger, C.; Bibron, R. (CEN, Saclay, France. Centre des Faibles Radioactivites, Gif-sur-Yvette, France). Geochim. Cosmochim. Acta, 32: 949-63(Sept. 1968). (In French).

The activities of 14 radionuclides from the Granes meteorite, which fell on 13 November 1964, were measured after chemical separation. The following results, expressed in dpm kg^{-1} at time of fall, were obtained: ^{10}Be: 23.4 ± 1.4; ^{26}Al: 37 ± 5; ^{41}Ca: 4.3 ± 1.0; ^{44}Ti: 1.8 ± 0.3; ^{45}Ca: 46 ± 6; ^{46}Sc: 18.5 ± 1.7; ^{49}V: 17 ± 4; ^{51}Cr: 118 ± 36; ^{53}Mn: 62 ± 8; ^{54}Mn: 57 ± 7; ^{55}Fe: 158 ± 17; ^{57}Co: 11 ± 3; ^{59}Ni: 10.5 ± 1.5; ^{60}Co: 6.4 ± 1.5. These results are discussed and compared with those obtained for the Harleton meteorite, which is similar in mass and chemical composition. By dividing the radionuclides into three groups according to their half-lives (less than 3 months; between 9 months and 3 years; greater than 40 years) it was established that these two meteorites received essentially identical irradiations during their exposure to cosmic rays. (auth) (UK)

47744 URANIUM DISTRIBUTION IN STONE METEORITES BY THE FISSION-TRACK TECHNIQUE. Fleischer, R. L. (California Inst. of Tech., Pasadena. General Electric Research and Development Center, Schenectady, N. Y.). Geochim. Cosmochim. Acta, 32: 989-98(Sept. 1968).

Uranium distributions in a group of stone meteorites were examined in situ on a microscale by the technique of fission-track activation, using a thin plastic overlay to detect the tracks. Changes in uranium concentration by factors of 10^5 were observed over distances of $\sim 10^{-2}$ cm. The nonuniformity in uranium content was such that in some samples regions of average uranium content were seldom found, making the usefulness of the term "average" doubtful. The ordinary chondrites of greater major-element disequilibrium were found to have increased nonuniformity in uranium content from one chondrule to another and higher values of uranium in the chondrules relative to the matrix material. (auth) (UK)

47745 IONIZATION STATE OF THE INTERPLANETARY PLASMA. Hundhausen, A. J.; Gilbert, H. E.; Bame, S. J. (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 73: 5485-93(Sept. 1, 1968).

Ionization processes in an expanding solar corona are discussed. Integration of the ionization equations demonstrates that the ionization state of the expanding coronal plasma "freezes in" deep in the corona and remains unchanged in transit through interplanetary space. The comparison with Vela satellite observations of solar wind oxygen ions makes possible the determination of the temperature of the coronal region from which the solar wind has emanated. For one particular example this leads to the identification of an active region on the solar disc as the source of the solar wind. Charge exchange with interplanetary neutral hydrogen is suggested to explain the observed presence of He^+ and O^{+5} in the solar wind. (auth)

47746 SOUTHERN TRIPLET OF GALAXIES. Sersic, J. L.; Pastoriza, M. G.; Carranza, G. J. (Observatorio Astronomico, Cordoba, Argentina. Instituto de Matematica Astronomia y Fisica, Cordoba, Argentina). Astrophys. Lett., 2: 45-7(Sept. 15, 1968). (In Spanish).

The nature of a peculiar triplet of galaxies is discussed and it is suggested that it has resulted from a violent event in the past. (auth)

47747 . INTERPRETATION OF RADIO ECHOES FROM THE SUN. Gordon, I. M. (Inst. of Radio Physics and Electronics, Kharkov). Astrophys. Lett., 2: 49-53(Sept. 15, 1968).

All the important and unexpected features of radio signals reflected from the Sun can be explained, if it is assumed that combination backscattering on ionic sound waves is responsible for the formation of a significant part of the components of the reflected signal. Analysis of the structure of the signal can give valuable information about layers of corona inaccessible to other methods of investigation. A number of desirable experiments are indicated. (auth)

47748 DISTANCES OF PLANETARY NEBULAE. Seaton, M. J. (University Coll., London). Astrophys. Lett., 2: 55-8 (Sept. 15, 1968).

Recent work on distances, masses, and space densities is discussed. In reply to a question raised in a recent letter by Gordon, it is pointed out that the surface brightness increases during the initial stage of the evolution of a planetary nebula. From this result alone, it follows that the central star luminosity must increase rapidly. (auth)

47749 NARROW-BAND DECASECOND EMISSIONS FROM JUPITER. Riihimaa, J. J. (Univ. of Florida, Gainesville). Astrophys. Lett., 2: 59-64(Sept. 15, 1968).

Some Jovian bursts with durations in the decasecond range may have bandwidths of as little as 50 to 100 kHz. There are indications that these emissions are sometimes formed by rapidly repeated pulses. Decasecond phenomena composed of two narrow bands of emission, separated by 200 to 300 kHz, are also recorded. These characteristics are not due to scintillation effects in the terrestrial ionosphere. (auth)

47750 STUDIES OF EXTRAGALACTIC NEBULAE. VI. THE ORTHOGONAL FAN JET IN M87. Walker, M. F. (Univ. of California, Mt. Hamilton). Astrophys. Lett., 2: 65-9(Sept. 15, 1968).

Spectroscopic observations of the central region of M87 reveal the existence of a fan-shaped emission jet whose maximum radial extent is about 16.8 arc sec in position angle = 355°. The radial velocity of this feature increases linearly with distance from the nucleus, and its characteristic expansion age is 2.1×10^8 years. (auth)

47751 ASSOCIATIONS OF REFLECTION NEBULAE AND LOCAL GALACTIC STRUCTURE. Van Den Bergh, S. (Univ. of Toronto). Astrophys. Lett., 2: 71-5(Sept. 15, 1968).

Fifteen associations of reflection nebulae are used to outline the Orion spiral arm. Near the Sun the arm appears to point in the direction $l^{II} = 70°$, $b^{II} = +10°$. (auth)

47752 LIGHT VARIATION OF SEYFERT GALAXY 3C120. Takayanagi, K. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Lett., 2: 77-9(Sept. 15, 1968).

The light curve of Seyfert galaxy 3C120 derived from examination of Harvard patrol plates taken during the years 1928 through 1943 shows that the photographic magnitude of this galaxy varies irregularly between $m_{pg} = 13.9$ and 15.5 mag on a time scale of years. (auth)

47753 OH EMISSION AT 1720 MHz IN THE DIRECTION OF NONTHERMAL GALACTIC SOURCES. Goss, W. M.; Robinson, B. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Astrophys. Lett., 2: 81-6(Sept. 15, 1968).

The position and polarization of the 1720-MHz OH emission from W28, W44, and the galactic center were measured. These sources represent a new class of OH emission objects where only the 1720 MHz line appears in emission, while the other three lines of the ground-state lambda-doublet are in absorption. This 1720 MHz emission has a low degree of polarization and an appreciable line width. In the case of W28 and W44 the emission comes from unresolved concentrations at the edge of shell-type nonthermal sources. (auth)

47754 VELOCITIES OF SMALL-SCALE INHOMOGENEITIES IN THE INTERPLANETARY MEDIUM. Ivanov, K. G.; Livshits, M. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 128-30(1968).

Translated from Geomagn. Aeron., 8: 162(1968).

The average field intensity and density for an epoch of low solar activity are used to estimate the velocity of electron concentration inhomogeneities of very small dimensions ($l \sim 100$ to 1000 km) in the interplanetary medium at distances from several solar radii to the orbit of the Earth. (TSS)

47755 OBSERVATION OF FAR ULTRAVIOLET RADIATION FROM EARLY-TYPE STARS. Yamashita, Koujun (Nagoya Univ., Japan). Astrophys. Space Sci., 2: 4-22(Aug. 1968).

Rocket-borne photon counters sensitive to bands $\lambda\lambda$ 1060 to 1180, $\lambda\lambda$ 1230 to 1350, and $\lambda\lambda$ 1350 to 1480 were used to measure the celestial ultraviolet radiation above the terrestrial atmosphere. The energy spectra of six objects, α Leo, β CMa, κ Ori, ζ, ϵ, δ Ori (combined), γ Ori, and ζ Tau were obtained. The comparison of these with those calculated with the stellar model atmospheres indicates the deficiency of about 1 mag. in the ultraviolet region, when corrected for interstellar extinction, for all stars except ζ Tau. The observed spectrum of ζ Tau agreed with the theoretical one for normal interstellar extinction. The effects of line blanketing were examined for B1 and B2 stars, and found to account for a part of the difference between the observed and the theoretical values. (auth)

47756 GRAVITY DARKENING IN ECLIPSING BINARIES. I. W URSAE MAJORIS-TYPE SYSTEMS. Kopal, Zdenek (Univ. of Manchester, Eng.). Astrophys. Space Sci., 2: 23-36(Aug. 1968).

A quantitative analysis of the ellipticity effect in close binary systems of the W Ursae Majoris type with spectroscopically known mass-ratios discloses that the photometric ellipticities of these variables are, in general, more than twice as large as the dynamical ellipticities (due to the geometrical distortion alone) computed for contact models of centrally condensed stars. If, moreover, this excess of the photometric over dynamical ellipticity is attributed to the phenomenon of gravity-darkening over distorted surfaces of the constituent components, this darkening must be present to a considerably larger degree than that predicted by the theory of radiative transfer—a result difficult to reconcile with the existence of extensive sub-surface convection zones in late-type main-sequence stars. If, on the other hand, gravity-darkening is present in W UMa-type systems in the amount predicted by the theory (let alone in the presence of sub-surface convection), the only effective way of reconciling the theory with the observations would be to assume that the mean fractional radii of their constituent components are appreciably larger than those appropriate for contact models in which the two components just fill the largest closed Roche equipotentials capable of containing their mass. In other words, it would appear that the W UMa-type stars considered in this paper may constitute a single dumb-bell figure rather than two distinct components; and that the observed variations of light, color, or radial velocity are invoked by the axial rotation (and consequent variable cross-section) of this dumb-bell figure rather than to the contribution of individual stars. (auth)

47757 HYDRODYNAMIC EQUATIONS OF DIFFERENTIALLY ROTATING STELLAR SYSTEMS AND THE VELOCITY ELLIPSOID. Kato, Shoji (Tokyo Univ.). Astrophys. Space Sci., 2: 37-47(Aug. 1968).

Anisotropic hydrodynamic equations for differentially rotating collisionless stellar systems are derived. These equations can describe the evolution of the systems in a time span longer than their rotation periods. As a by-product of derivation of hydrodynamic equations, the well-known relation that the ratio of the principal axes of the velocity ellipse in a differentially rotating stellar disk is $[B/(B-A)]^{\frac{1}{2}}$ is re-found if the system is in a purely circular rotation, where A and B are the Oort's constants. In addition, it is found that a systematic mean motion superposed on a purely circular differential rotation makes the directions of axes of the velocity ellipse deviate from the radial and the transverse direction. The observed deviation of directions of axes in the neighborhood of the Galaxy close to Earth can be explained if in the mean motion superposed on a purely circular differential rotation the "gas" of near stars is compressed in the radial direction or rarefied in the transverse direction, with irregularities of the order of 5 km/sec in amplitude of velocity and 1 kpc in size. These magnitudes of irregularities agree with those actually observed or with those anticipated from other theoretical considerations. (auth)

47758 DYNAMICAL TIDES IN CLOSE BINARY SYSTEMS. IV. TIDAL LAG. Kopal, Zdenek (Univ. of Manchester, Eng.). Astrophys. Space Sci., 2: 48-60(Aug. 1968).

Differential equations governing the dynamical tides in close binary systems consisting of centrally condensed components of viscous gas are split up in their real and imaginary parts, the ratio of which defines the tidal lag. These equations are particularized to a case in which the central mass-point of each star is surrounded by an evanescent envelope the density of which decreases as the inverse square of the central distance. It is shown that self-gravitating configurations built up in accordance with this model are incapable of performing free nonradial oscillations with a frequency ω comprised between $0 \leq \omega^2 \leq \infty$; but explicit expressions for forced oscillations representing dynamical tides are given for an arbitrary form of the external field of force. Equations for the imaginary components of the displacement, constructed for the same model, disclose that if the viscosity of stellar material is identified with that of hydrogen plasma, the tidal lag due to a viscous dissipation of kinetic energy may produce dynamical effects, the cumulative outcome of which becomes appreciable on the Kelvin time scale, but over short intervals of time their stationary photometric effects should be negligible. The latter can become observationally significant only for stars in which turbulent viscosity under near-adiabatic conditions becomes an important factor. (auth)

47759 PHOTOMETRIC REFLECTION EFFECT IN CLOSE BINARIES. Napier, W. McD. (Royal Observatory, Edinburgh, Scotland). Astrophys. Space Sci., 2: 61-82(Aug. 1968).

A method for evaluating the photometric consequences of the reflection effect in close binaries is described. There is no restriction on the extent of the penumbra and the conversion to monochromatic radiation avoids the ambiguity of the approach based on application of a luminous efficiency factor. The reflected radiation is taken to have a phase law of the form $(1 - u_r + u_r \cos\theta)$ where θ represents the angle between the local normal and the observer's line of sight. An estimate of the accuracy of the method is made; it is found that it is suitable for the reduction of light curves of high precision for all systems except those where the components are in contact or almost so. (auth)

47760 POPULATION II MAIN SEQUENCE. Castellani, V.; Renzini, A. (Centro di Astrofisica, Rome). Astrophys. Space Sci., 2: 83-95(Aug. 1968).

Results of calculations of main sequence stellar models for metal poor stars are presented. A fictitious pre-main sequence evolution was computed in order to give the distribution of the primary elements H, ^{3}He, ^{4}He, ^{12}C, ^{14}N, and ^{16}O in the stellar interior. The selected initial chemical composition was X = .9, Z = .001. Comparison with previous results indicates a lifetime of the main-sequence phase shorter than it was believed before. (auth)

47761 SUPERNOVAE EXPLOSIONS INDUCED BY PAIR-PRODUCTION INSTABILITY. Fraley, Gary S. (California Inst. of Tech., Pasadena). Astrophys. Space Sci., 2: 96-114 (Aug. 1968).

Stars with a core mass greater than about 30 $M_\odot$ become dynamically unstable due to electron–positron pair production when their central temperature reaches 1.5 to 2.0×10^9 °K. The collapse and subsequent explosion of stars with core masses of 45, 52, and 60 $M_\odot$ are calculated. The range of the final velocity of expansion (3400 to 8500 km/sec) and of the mass ejected (1 to 40 $M_\odot$) is comparable to that observed for type-II supernovae. A dynamical model of convection is derived and included in the calculations. It was found that the effect of the convection on the explosions is probably not important. (auth)

47762 RELATIONS BETWEEN SPECTRAL CHARACTERISTICS AND STATISTICAL POPULATION INDICES OF MIRA

TYPE VARIABLES. Iwanowska, Wilhelmina (Copernicus Univ., Torun, Poland). Astrophys. Space Sci., 2: 128-33(Aug. 1968).

Line and band intensities of Mira-type variables from Keenan's Catalogue (1966) and some other sources are discussed in relation to statistical population indices characterizing positions and motions of these stars. Residual intensity estimates of Ca 4226, Cr 4254, TiO, VO, ScO, YO prove to be stronger in population-I Miras, whereas H_δ em line is definitely stronger in population-II stars. The coefficient of correlation between residual line or band intensity and the partial statistical population index, depending principally on the star distance to the galactic plane, grows with increasing mass number of the corresponding element. (auth)

47763 IS THE THIRD INTEGRAL A FUNCTION OF THE HAMILTONIAN? Contopoulos, G.; Barbanis, B. (Univ., Thessaloniki, Greece). Astrophys. Space Sci., 2: 134-45(Aug. 1968).

Numerical evidence is presented which indicates that, although the third integral is tangent to the Hamiltonian (energy integral) along some periodic orbits (as has been shown by Goudas), it is not tangent to it along non-periodic orbits; therefore it is not a function of the Hamiltonian. The set of periodic orbits is probably dense in general, but a given form of the third integral is valid in the neighborhood of a limited number of them; no form of the third integral is valid for all periodic orbits, except in integrable cases. (auth)

47764 THIRD INTEGRAL AND THE HAMILTONIAN. Goudas, C. L. (Univ., Patras, Greece). Astrophys. Space Sci., 2: 146-8 (Aug. 1968).

It is reiterated that any suggestion of the existence of a "third integral" is at variance with Poincaré's theorem on the nonexistence of such integrals. Even in a purely numerical approach no form of a new "integral" can be constructed that is valid in every domain of the phase space; and it is devoid of meaning to use as a "third integral" different forms of functions in various cases. (auth)

47765 CLARIFICATION NOTE ON SYNCHROTRON EMISSIVITY. Takakura, T.; Uchida, Y. (Tokyo Univ.). Astrophys. Lett., 2: 87(Sept. 15, 1968).

Recently Schener (1969) pointed out that the correction factor $\sin^{-2}\theta$ derived by Epstein and Feldman (1967) for the synchrotron emission from a single electron in a helical orbit with a pitch angle ϕ is cancelled out if one considers the time average of the power emitted from a fixed volume element. Consequently, such a correction is not necessary for the interpretation of such emission from radio sources. Here θ is an angle between the magnetic field and the direction of observer, and $\theta \approx \phi$. A recent letter by the authors (1968) in which they emphasized the necessity of the $\sin^{-2}\theta$ factor has also to face this criticism. (W.D.M.)

47766 VELOCITIES OF PERMITTED AND FORBIDDEN LINES IN NOVA DELPHINI 1967. Wallerstein, G. (Univ. of Washington, Seattle). Astrophys. Lett., 2: 89-90(Sept. 15, 1968).

The spectrum of Nova Del 1967 as observed nearly one year after outburst is described. Absorption lines of H and He are present at velocities of –1250, –1080, and –440 km/sec. Permitted and forbidden emission lines are present showing structural features at 0, +400, and +1200 km/sec in addition to the negative components shown by absorption lines. (auth)

47767 MIXING IN THE SUN AND NEUTRINO FLUXES. Bahcall, J. N.; Bahcall, N. A.; Ulrich, R. K. (California Inst. of Tech., Pasadena). Astrophys. Lett., 2: 91-5(Sept. 15, 1968).

The effect of mixing on the solar neutrino fluxes was calculated for various fractions of a solar lifetime and mass. The stability of the solar interior to the principal known mechanisms of mixing was investigated. It is concluded that mixing of the speed and duration necessary to significantly affect the solar neutrino fluxes is unlikely to occur. (auth)

47768 BRIGHTNESS FLAREUP OF COMET 1963 III (ALCOCK 1963b). Grudzinska, S. (Univ. N. Copernic, Torun-Piwnice, Poland). Acta Astron., 17: 155-60(1967). (In French).

The observed flareup of this comet was connected with geomagnetic perturbations excited by a solar corpuscular beam. The beam originated in eruptions observed in active centers No. 19 and No. 20 of solar rotation No. 1467 and was propagating at a velocity of ~1940 km/sec. (Meteorol. Geoastrophys. Abstr.)

47769 NOTE ON THE SPECTRUM OF COMET 1963 III (ALCOCK 1963b). Grudzinska, S. (Univ. N. Copernic, Torun-Piwnice, Poland). Acta Astron., 17: 161-3(1967). (In French).

Spectral observations of this comet exhibited a continuous spectrum and an enhanced group at 4050 Å. After the flareup of the comet, observed on May 28, 1963, the intensity of the bands and the continuum increased. The bands were identified and are tabulated. (Meteorol. Geoastrophys. Abstr.)

47770 SODIUM D LINES IN COMET 1965-f NEAR PERIHELION PASSAGE. Evans, Charles; Malville, J. McKim (High Altitude Observatory, Boulder, Colo.). Publ. Astron. Soc. Pac., 79: 310-16(Aug. 1967).

Observations of D lines in comet Ikeya-Seki are discussed. The high value of 2.5 in the observed D_2/D_1 intensity ratio in the comet is unexplained. A series of slitless spectrograms with sufficient resolution to separate the images of the comet in D_1 and D_2 were acquired in addition to slit spectra. The steady decrease of the D_2/D_1 ratio in the head of the comet during the afternoon indicated a gradual increase in the number of sodium atoms/cm^2 column as the comet approached the Sun. The D lines are probably formed by resonance scattering of solar radiation in a situation very similar to the formation of D lines in the dayglow of the Earth's atmosphere. Variations of D_1 and D_2 along the cometary axis at 2241 U.T. and 2337 U.T. are shown in graphs. (Meteorol. Geoastrophys. Abstr.)

47771 SUPERNOVA 1962a OF TYPE I IN THE COMA CLUSTER OF GALAXIES. Zwicky, F. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena); Barbon, R. Astron. J., 72: 1366-7; 1382(Dec. 1967).

This supernova was discovered by Zwicky on the night of 6–7 January 1962 on a plate obtained with the Palomar 48-in. Schmidt telescope. The parent galaxy is an anonymous E or SO type galaxy at R.A. 13^h04^m3 and Dec. +28°08′ (epoch 1950.0) of apparent photographic magnitude $m_p = 15.6$. The galaxy has a core of high surface brightness which appears stellar on the 48-in. Schmidt plate and has an apparent photographic magnitude $m_p \cong 18.0$. An average symbolic velocity of recession (V_s) = 6137 + 77 Km/sec is obtained. The indicative distance and absolute photographic magnitudes of the galaxy and of its core are respectively: D = 61.4×10^6 pc, M_p (galaxy) = –18.3, M_p (core) ≅ –15.9. The supernova appeared at 11″ west and 7″ north of the nucleus of the galaxy described in the preceding. The photovisual and the photographic magnitude at maximum brightness were both very closely equal to that of the whole parent galaxy itself. The spectrum shows the characteristic 5 bands of a supernova of type I in the blue plus a band at λ3660.0 Å in the uv usually not seen. Because of this band SN 1962a near the maximum was bluer than other supernovae of the same spectral type. Average ratios of the wavelengths λ_i observed for the peaks of the 5 characteristic blue bands of supernovae of the type I are tabulated, together with the corresponding ratios for the bands observed in the blue for SN 1962a. (BBB)

47772 THE CORRELATION OF LOCAL SOLAR MAGNETIC FIELDS WITH CENTRAL INTENSITIES OF Hα AND K3 LINES. von Klueber, H. (Cambridge Univ., Eng.). Observatory, 88: 45-8(Apr. 1968).

A description is given of simultaneous measurements, using a Babcock magnetograph, of the longitudinal component of the solar magnetic field, the central intensity of Hα, and the central intensity of K3. For the central intensities two photomultipliers were used (one at the line center and the other in the adjacent spectrum outside the line). Gauss values of the local magnetic field components and intensity fluctuations in the centers of the Hα and K3 lines are plotted. (IAA)

47773 BRIGHTNESS VARIATIONS OF THE COMET ALCOCK 1963b AND THEIR CORRELATION WITH SOLAR PHENOMENA. Ferrin [V.], Ignacio (Asociacion de Estudios Fisicos, Caracas). Acta Cient. Venez., 17: 17-21(1966). (In Spanish).

The correlation between the observed integrated visual magnitude of comet 1963b and the relative sunspot number is described. A relative sunspot maximum is always followed by a maximum of absolute intensity, and likewise for minima. The interaction time (between sunspot maximum and intensity maximum) is found to decrease from 10 to 6 days as R (the number of spots) increases. The deviations observed are similar to those found for analysis of magnetic perturbations of the Earth. The mechanism of outbursts is described as a function of the relative positions of Sun, comet, and Earth. Outbursts of the comet's nucleus on 29 May are correlated with a moderate magnetic perturbation of the Earth of 27–28 May; particle velocity is thus deduced to be between 570 and 900 km/sec. (BBB)

47774 SPECTRAL PROPERTIES OF THE X-RAY OBJECTS GX 3 + 1, GX 354-5, AND Sco XR-1. Buselli, G.; Clancy, M. C.; Davison, P. J. N.; Edwards, P. J.; McCracken, K. G.; Thomas, R. M. (Univ. of Adelaide). Nature (London), 219: 1124-7 (Sept. 14, 1968).

The spectra of three x-ray objects were measured from a balloon, and suggest that the sources are supernova remnants,

and that the x-ray emission is due to magnetic bremsstrahlung. (auth) (UK)

47775 DISTRIBUTION OF X-RAY EMISSION FROM THE SUN DEDUCED FROM MEASUREMENTS OF IONOSPHERIC ABSORPTION. Anastassiadis, M.; Boviatsos, D. S. (Univ. of Athens). Nature (London), 219: 1139-41(Sept. 14, 1968).

Reference is made to measurements of solar flux and ionospheric absorption over parts of N. Africa and S. Europe during the annular solar eclipse of May 20, 1966. Solar flux was measured at various frequencies in the cm and mm bands, and all the data showed characteristic variations in flux related to local active sources on the solar disk. Three sources showing an increase in flux were identified: one on the west limb, another in the middle of the disk, and the third on the east limb. Two lesser sources were also identified on the NE part of the disk. The time derivatives of flux from the active sources and of ionospheric absorption were found to be closely correlated, indicating that the three main centres of activity are also centres of strong x-ray emission, producing absorption in the D layer. Absorption effects were not observed in the E layer, except for sources emitting soft x rays. It is concluded that sources emitting hard x rays are responsible for the absorption effect in the D layer, and that soft x rays, especially those located in the limb of the solar disk, are associated with absorption in the E layer. (UK)

47776 INTERSTELLAR OH EXCITATION. Stecher, T. P. (Goddard Space Flight Center, Greenbelt, Md.); Williams, D. A. Nature (London), 219: 1138-9(Sept. 14, 1968).

It has been concluded that the 18-cm radio emission from the OH molecules located at the edges of H II regions is a stimulated emission in a collimated beam, and the problem of explaining the emission reduces to a description of the mechanism by which the upper levels in the masering state of the molecule are overpopulated with respect to a thermal distribution. It has been argued that because the OH is situated close to an H II region its lifetime must be short, so that overpopulation may be a result of the production mechanism. A mechanism of chemical exchange for the formation of OH is discussed, from this point of view, the exchange action being represented by O + H-(Grain) → OH + Grain + Q. The heat of reaction, Q, may appear as kinetic, electronic, vibrational, or rotational energy. Formation of OH is discussed in terms of energy hypersurfaces and Polanyi's conclusions (J. Chem. Phys. 31: 1338(1959)). In the above exchange "Grain" refers to graphite grains, and "H-(Grain)" to H atoms bound on graphite grains. The important conclusion may be reached that the OH molecule will most often be formed in the v = 1 level, since this requires only 40% of the heat of reaction, and is only a single transition away from the ground level. Since the OH sources are located at the edges of H II regions it is reasonable to expect that the grains involved in OH production are driven through the gas either by radiation pressure or general turbulence. A limitation of the mechanism is that it does not consider the individual lines in the OH spectrum. (UK)

47777 SPECTRAL CHANGES ON HD 125823. Jaschek, M.; Jaschek, C.; Kucewicz, B. (Observatorio Astronomico, La Plata). Nature (London), 219: 1137-8(Sept. 14, 1968).

Since the first spectra of HD 125823 were taken in 1908, the spectrum has varied between two extreme types which can be roughly described as B2 and B8III. The present communication describes a series of spectrograms taken on successive nights in May 1968 with the 110 Å mm^{-1} camera of the 32-in. reflector at La Plata. The star shows a very short cycle of the order of 9 days. In the course of three cycles its behaviour was periodic, the same spectra repeating exactly at the same phases. The short cycle or period poses difficult questions regarding the nature of the star. The simplest hypothesis is that of a binary system, but this involves several difficulties, which make acceptance very difficult. Another possibility is that the star pulsates; but no large changes in luminosity are observed. A third possibility is to relate the variation of spectral type with the existence of a very hot patch of matter which moves across the visible hemisphere due to rotation of the star, but the constancy of the C II, Mg II, and Si III lines argues against this hypothesis. (UK)

47778 DISTANCES TO THE PULSATING RADIO SOURCES. Habing, H. J.; Pottasch, S. R. (Univ. of Groningen, Netherlands). Nature (London), 219: 1137(Sept. 14, 1968).

It has been assumed in some recent papers that the distance of pulsars is of the order of 100 pc or less. The present authors attempt to show that it is just as likely that these objects lie at distances at least ten times greater. In studies on the subject the delay in pulse arrival was measured at several frequencies, and it was assumed that the change in arrival time with frequency can be explained entirely by a dispersion in group velocity in ionised gas. From this the integral $\int n_e dl$ was obtained, where n_e is the electron density and l is the distance; typical values for this integral are 10 cm^{-3} pc. Then, if the average value of n_e in the interstellar medium near the local region of the galactic plane is assumed to be 0.1 cm^{-3}, a distance of 100 pc to the pulsating source follows. The authors, however, question the use of 0.1 cm^{-3} as an average value of the electron density in the interstellar medium, and conclude that it does not seem justifiable to place any reliance on pulsar distances of less than 100 pc. (UK)

47779 EXTRAGALACTIC RADIO BACKGROUND AT 2.1 MHz. Bridle, A. H. (Queen's Univ., Kingston, Can.). Nature (London), 219: 1136-7(Sept. 14, 1968).

The extragalactic background would be expected to contribute about 75% of the total brightness at galactic latitudes >30° at an observing frequency near 2 MHz if no allowance is made for the effects of free–free absorption within the Galaxy. A recent survey of the radio background at 2.1 MHz indicated that the contribution at that frequency is considerably lower, and it is concluded that intergalactic free–free absorption could be partly responsible for the observed effect at 2.1 MHz. (UK)

47780 STATISTICAL PROPERTIES OF PULSAR CP 1919. Wielebinski, R. (Univ. of Sydney). Nature (London), 219: 1135(Sept. 14, 1968).

The Parkes data (Nature 217: 709(1968)) were examined for statistical occurrence properties, and a quantitative description of the source is given. The statistics of pulse occurrence are of interest since theories of emission and pulse propagation require these data, and such statistics are also of assistance in determining an observational programme. Studies were concentrated on the pulse amplitude occurrence statistics for the pulsar CP 1919 at the frequencies observed at Parkes. The mean values of pulse amplitude at each frequency were determined from long integrations made in a sequential computer, synchronised to the pulse period, and the pulse occurrence data were derived from chart records made with a time constant of 0.1 sec. A selection was made of charts where a nearly continuous record was available for at least 5,000 pulses (2 hr. tracking). Histograms of pulse occurrence are shown for 5 flux unit steps, at 150 and 630 MHz. Increases in flux amplitude of pulses in the form of bursts were observed at least once every 200 pulses at 150 MHz. At 630 MHz pulses were weak for some 4,000 pulse periods and then consistently strong for some 500 pulses. At 1,410 MHz very few pulses were observed. It is concluded that the statistics of pulse occurrence give a complicated picture of the behaviour of pulsars. For pulsar searches it would seem that a frequency near 150 MHz is optimum, with a tracking period of 5 min. for each sky point. (UK)

47781 MAGNETO-GRAVITY WAVES AND THE HEATING OF THE SOLAR CORONA. McLellan IV, Alden; Winterberg, F. (International Centre for Theoretical Physics, Trieste, Italy). Solar Phys., 4: 401-8(Aug. 1968).

It is generally believed that the heating of the solar corona is caused by waves originating in the photosphere and propagating into the corona where their energy is dissipated. The medium through which these waves propagate is in general permeated by magnetic fields complicating the behavior of this propagation considerably. The wave motions in a plasma permeated by constant magnetic and gravitational fields were therefore analyzed. In general, three wave modes were found, which were called the + mode, −mode, and the Alfvén mode. Each mode was found to be strongly coupled to each of the three kinds of motion; acoustic, gravity, and hydromagnetic. However, the Alfvén mode was found to be separable from the dispersion relation, and therefore independent of compressibility and gravity. The local dispersion relation is derived and expressed in nondimensional form independent of the constants that describe a particular atmosphere. From the dispersion relation one can show that rising waves propagate either with a constant or a growing wave amplitude depending on the magnitudes and directions of the gravitational field, magnetic field, and the wave vector. The variation of the density with height is taken into account by a generalized WKB method. Equations are found, which give the height at which wave reflection occurs, giving the upper bound for possible wave propagation. (auth)

47782 INTERPRETATION OF THE ABSORPTION-LINE REDSHIFTS IN THE SOLAR SPECTRUM. Pasachoff, Jay M.; Silk, Joseph I. (Harvard Coll. Observatory, Cambridge, Mass.). Solar Phys., 4: 474-5(Aug. 1968).

A proposal by Kierein and Sharp [Solar Phys., 3: 450 (1968)]

that the observed red shift of solar absorption lines results from Thomson scattering of photons by free electrons in the solar atmosphere is discussed. Several shortcomings or difficulties in the proposal are pointed out. (A.G.W.)

47783 CHROMOSPHERIC MAGNETIC FIELDS ASSOCIATED WITH SUPERGRANULATION. Clark, Alfred Jr. (Univ. of Rochester, N. Y.). Solar Phys., 4: 386-400(Aug. 1968).

Some theoretical models are given, which illustrate the structure of chromospheric magnetic fields associated with supergranulation. It is found that the chromospheric fields depend critically on whether or not there are large-scale vertical motions at the level where the horizontal supergranule motions are observed. In the absence of such motions, the concentration of field produced in the photosphere does not persist more than a few scale heights into the chromosphere; however, the chromospheric mass density is increased above the supergranule boundaries in this case. Completely different results—such as chromospheric potential field—may be obtained by the inclusion of vertical motions. It is concluded that a rather wide range of chromospheric-field structures is consistent with present observational knowledge of the supergranulation. (auth)

47784 DEVELOPMENT OF MAGNETIC FIELDS IN ACTIVE REGIONS. Bappu, M. K. V. (Kodaikanal Observatory, India); Grigoriev, V. M.; Stepanov, V. E. Solar Phys., 4: 409-21(Aug. 1968).

Transverse and longitudinal magnetic-field scans together with K_{232} spectroheliograms that cover the early phases of active-region formation reveal the following: (a) The new active region forms near the periphery of an old magnetic region. There is evidence that the new region forms an interrelated system with the old structures on the sun. (b) Noticeable changes in the background magnetic field are seen nearly 3 days prior to the appearance of the sunspot. Magnetic hills of the longitudinal component appear along with bright localized K_{232} emission. Subsequently the K_{232} emission spreads along the boundary of one or two adjacent supergranules and at the time of sunspot formation occupies the whole supergranular cell. (c) Transverse fields with strengths of 100 to 150 gauss form closed regions in the area of the longitudinal component hills, in the very early phases of the region. These fields stretch and link up the two areas later, at which time the peak transverse fields with values near 250 gauss coincide with the zero line of the longitudinal field. When subsequently the spots appear in the new region, the transverse fields are located about the hills of the longitudinal field. The total field vectors just prior to sunspot formation are pressed to the surface. These are inclined about 45° to the surface after the spot appears. The findings indicate that the magnetic field of a new region emerges from the subphotospheric layers. It is highly likely that the dynamics of a supergranule influences only the emergence of the magnetic field into the upper layers of the solar atmosphere. (auth)

47785 HIGH-RESOLUTION PHOTOGRAPHY OF THE SOLAR CHROMOSPHERE. III. THE FINE STRUCTURE OF A CLASS I FLARE. Loughhead, R. E. (CSIRO, Sydney). Solar Phys., 4: 422-7(Aug. 1968).

Preliminary results of a program of flare photography being undertaken with the 30-cm refractor of the C.S.I.R.O. Solar Observatory at Culgoora are described. When a flare is reported, a few photographs are first taken with a normal exposure, and then successive small groups of photographs are taken with approximately 0.7, 0.5, 0.3, and 0.15 times the normal exposure, the cycle being repeated through the lifetime of the flare. Three distinct types of structural detail are revealed by this technique in the flare shown: rather vaguely defined diffuse sheets, small bright condensations, and narrow bright filaments. (A.G.W.)

47786 DIRECTIVITY OF SOLAR MICROWAVE BRIGHT REGIONS. Rao, U. V. Gopala (Astrophysical Observatory, Kodaikanal, India). Solar Phys., 4: 428-31(Aug. 1968).

Stanford microwave spectroheliograms (9.1 cm λ) were used to investigate the directivity of bright regions of relatively weak intensity observed during 1963 to 1965. The maximum brightness temperature of a source as its position changes from limb to limb was noted for each day. It was observed that maximum emission occurs about 5 days before CMP for weak regions, and that this peak shifts gradually toward the central meridian with increase in the intensity of the source. The asymmetry observed for relatively weak sources is significant and conspicuous. To explain the observed behavior, it is suggested that the radio emission from the active regions may have two components: one with symmetrical directivity, whose intensity varies during the sunspot cycle, and a weak emission with an asymmetrical directivity. (A.G.W.)

47787 DECAMETRIC RADIO SPECTRA AND POSITIONS DURING THE FLARE OF AUGUST 28, 1966: 1522 UT. Warwick, James W. (Univ. of Colorado, Boulder). Solar Phys., 4: 446-52(Aug. 1968).

During a period of intense decametric continuum arising near the center of the sun, there occurred additional very strong emission closely associated with the flare beginning at 1522 UT on August 28, 1966. Owing to strong ionospheric absorption from about 1527 UT on, which eliminated telecommunications interference, the frequency range over which the flare-associated emission appears is unusually large, from the upper limit of the spectrograph, 41 MHz, to about 11 MHz, where external reflection cuts off the solar signals. Strong bursts of Type III (fast drift) occur from 1527 to 1531 UT, and a complex Type II (slow drift) from 1532 to 1547 UT. As the Type-II burst progresses at frequencies from 15 to 25 MHz, northward position shifts of many solar radii probably take place; at higher frequencies the burst moves in a complicated pattern through a much narrower range of distances to the north of the sun. Type-IV emission, from 1540 UT on, moves a large distance to the sun's north, and then, after 1600 UT, returns to a stable position quite close to the sun. (auth)

47788 THEORY OF DECA-keV SOLAR X-RAY BURSTS. Snijders, R. (Space Research Lab., Utrecht). Solar Phys., 4: 432-45(Aug. 1968).

An attempt has been made to investigate theoretically the time profile of an x-ray burst observed at photon energies well below 0.5 MeV.' Following De Jager (1967) this type of x bursts is called deca-keV x-ray bursts. The energy distribution of fast electrons that emit the hard x-ray burst has been computed as a function of time. On the basis of these expressions the time profile of a deca-keV burst has been calculated. Two plausible initial electron distributions were chosen, a monoenergetic distribution and a Maxwellian distribution of electron energies. It has been proved that the process of energy loss of an electron is completely governed by losses due to magnetic bremsstrahlung emission. This implies that the decay shape of a deca-keV x-ray burst is determined by the value of the magnetic-field strength existing in the plasma. A typical decay time of an x-ray burst, which is about 3 min, can be expected theoretically from a thermal plasma of temperature 10^9 °K confined by a magnetic field of about 750 gauss. The theory developed in this paper indicates that the soft x-ray burst accompanying the deca-keV burst lasts much longer than the deca-keV burst itself. (auth)

47789 DENSITIES OF INTERSTELLAR HYDROGEN CLOUDS. Ahlborn, B. (Univ. of British Columbia, Vancouver). Can. J. Phys., 46: 1661-7(Aug. 1, 1968).

With simple gas dynamical theory one can calculate three properties of plane and steady supersonic discontinuity fronts: the compression ratio ρ_2/ρ_1, the density of the undisturbed medium ahead, and the power input W per unit area of front. These calculations do not require knowledge of the absorption mechanism or the spectral distribution of the absorbed (or emitted) radiation, but are based on measurements of particle velocity, density, and temperature behind the front. The calculations were applied to radio observations of galactic H II regions by Mezger and Henderson (1967) and Mezger and Höglund (1967). The derived average density for 11 hydrogen clouds surrounding the observed H II regions corresponds to $n(HI) = 50\ cm^{-3}$, assuming complete dissociation. The objects Orion A and IC 434 stand out with $n(H\ I) = 450$ and $405\ cm^{-3}$, respectively. The average power input is $\overline{W} = 5 \times 10^{-3}\ erg/cm^2\ s$. (auth)

47790 TABLES OF RADIO-FREQUENCY RECOMBINATION LINES. Lilley, A. E.; Palmer, Patrick (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. J., 16: Suppl. Ser. No. 144, 143-73(Aug. 1968).

The rest frequencies of radio-frequency recombination lines of hydrogen and helium were computed and tabulated. The tabulation covers the complete range of frequencies normally used for radio astronomical observations. Transitions with $\Delta n = 1$ through $\Delta n = 5$ are included for hydrogen and $\Delta n = 1$ and $\Delta n = 2$ for helium. Table 1 provides the rest frequencies when the transition is specified. Table 2 provides the rest frequencies in sequence and identifies the transitions. The combined tables offer a convenient reference for planning observations and identifying spectra. Formulae are given from which rest frequencies of heavier elements with arbitrary ionization can be computed with the aid of the tables. Problems associated with line identification are discussed. (auth)

Atomic and Molecular Physics

Refer also to abstracts 48110, 48265, 48507, and 48618.

47791 (MLM-1553(tr)) SCATTERING OF HELIUM ATOMIC BEAMS IN RARE GASES. Beier, Hans-Joachim. Translated by William L. Taylor (Mound Lab., Miamisburg, Ohio), from Z. Phys., 196: 185-202(1966). 22p. Dep. CFSTI.

The scattering of helium atomic beams in rare gases is investigated by measurements of total scattering cross sections. With the device described the dependence of total scattering cross sections on the relative velocity of the scattering atoms was measured. For variation of the beam velocity in the range of 1:8 a helium beam source was used which could be cooled down with liquid helium from room temperature to 4.8°K. The detector is of the universal-detector-type. A Wien filter is used as mass filter. The lowest detectable particle density is 6.3×10^3 He atoms/cm^3. The measured scattering cross sections are in qualitative agreement with the theory of Bernstein. (auth)

47792 (N-68-24734) DOUBLY EXCITED STATES OF H^- OF HIGH PRINCIPAL QUANTUM NUMBER: IMPLICATIONS FOR ELECTRON-ATOM IONIZATION. Temkin, A.; Bhatia, A. K.; Sullivan, E. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1968. 38p. (NASA-TM-X-63214; X-641-68-177). CFSTI.

Insight into the threshold region of electron-atom ionization can be gained by examination of the nature of the doubly excited states of the compound ion. A study of these states for H^- has been initiated with two types of variational wave functions. One, ψ_W, has the two electrons at roughly equal distances from the nucleus; the other, ψ_D, has one electron at a very much farther distance such that it sees the dipole potential caused by the inner electron and the nucleus. Both functions are constructed to be eigenfunctions of the operator Q_N, which projects out all states of the target of principal quantum number less than N, and renders the energy subject to a minimum principal. If the number of states for which ψ_W yields a lower energy than ψ_D is proportional to N^γ then an extrapolation argument shows that the threshold yield curve will be effectively proportional to $E^{(3-\gamma)/2}$. Calculations have been done to N = 5 for ψ_D and N = 9 for ψ_W. Only the lowest of the ψ_W states is lower than the corresponding ψ_D state. The results suggest γ in the range $0 < \gamma \leq 1/2$. Some comments on Wannier's theory of ionization are made. (auth) (STAR)

47793 (NP-17616) SURFACE AND VACUUM PHYSICS INDEX. Volume 3, No. 6 (677-853). Hilsenbeck, D. (ed.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 94p. Dep.

One-hundred and seventy-six references on various aspects of surface and vacuum physics are listed. Subject and author indexes are included. (M.O.W.)

47794 PRESSURE BROADENING AND SHIFT OF TITANIUM LINES BY ARGON. Dahmen, Manfred; Kusch, Hans Juergen (Univ., Kiel). Z. Astrophys., 68: 445-60(1968). (In German).

Broadening and shift of 153 titanium lines by van der Waals interaction with argon atoms was measured using a King's furnace. Interaction constants and Weisskopf impact radii were obtained from the half widths and shifts and compared with the results of theoretical calculations and of arc measurements. (auth)

47795 MEASUREMENTS OF ArII TRANSITION PROBABILITIES AND THE CONTINUOUS SPECTRA OF Ar AND Ne. Schnapauff, Rudolf (Univ., Kiel). Z. Astrophys., 68: 431-44(1968). (In German).

Absolute transition probabilities were obtained for 75 Ar II lines using intensity measurements in a cascade arc and previously determined lifetimes for the upper levels of some of the lines. Between 2600 and 6600 Å continuous absorption coefficients for the free-bound transitions of Ar and Ne were measured in the same light source. Satisfactory agreement with theoretical values was found. (auth)

47796 ABSOLUTE PHOTOELECTRIC CROSS-SECTIONS OF 280 keV GAMMA-RAYS IN Ta, Cd, AND Cu. Raja Rao, M.; Parthasaradhi, K.; Jnanananda, Swami (Andhra Univ., Waltair, India). Curr. Sci. (India), 37: 401-2(July 20, 1968).

The results of photoelectric cross-section measurements in Ta, Cd, and Cu at gamma energy of 280 keV are presented. (M.O.W.)

47797 MAGNETIC PARAMETERS FOR THE CONFIGURATION f^3. Crosswhite, Hannah; Crosswhite, H. M.; Judd, B. R. (John Hopkins Univ., Baltimore). Phys. Rev., 174: 89-94(Oct. 5, 1968).

The energy-level schemes of several atomic configurations f^3 are analyzed in terms of effective operators. These include all possible Hermitian two-electron scalar operators and six three-body spin-independent scalar operators. This collection of operators allows for spin-spin and spin-other-orbit interactions as well as for the most important effects of configuration interaction. Several alterations and extensions are suggested for the terms of Pr III $4f^3$. The positions of the free-ion levels of Nd IV $4f^3$ and Er IV $4f^{11}$ are inferred from the crystal spectra of Nd^{3+} in $LaCl_3$, and analyses with restricted sets of operators are carried out. (auth)

47798 HYPERFINE STRUCTURE OF THE $(p\mu p)^+$, L = 1, ORTHO, BOUND STATE. Halpern, Alvin M. (City Univ. of New York, Brooklyn). Phys. Rev., 174: 62-7(Oct. 5, 1968).

All of the ordinary hyperfine terms of the $(p\mu p)^+$, L = 1, ortho, bound state, except for the muon-proton contact term, are evaluated to sufficient accuracy so that they would not mask a hyperfine discrepancy associated with proton structure effects. These and other pertinent contributions to the hyperfine structure are discussed in the light of recent interest in checking for a discrepancy in the hyperfine structure of a muon-proton system. (auth)

47799 FORMAL PROBLEMS IN THE THEORY OF DISSOCIATIVE ATTACHMENT AND RECOMBINATION. Chen, Joseph C. Y. (Univ. of California, San Diego); Mittleman, Marvin H. Phys. Rev., 174: 185-93(Oct. 5, 1968).

A brief history of the theoretical work on the problem of dissociative attachment and recombination is given. Formal difficulties concerning the joining of resonance states and asymptotic physical states in some previous theories are pointed out. A new development using projection-operator techniques and eliminating these difficulties is given. The new equations yield a different physical interpretation of the process. The first step is a capture into a resonance intermediate state as in previous theories, but now a subsequent transition of the Landau-Zener type is necessary for a stabilization of the process. This is a new feature not present in previous theories. A reason why previous theories that do not contain this new feature can give the same numerical results as this one is given. (auth)

47800 CHARGE-EXCHANGE COLLISIONS BETWEEN HELIUM IONS AND CESIUM VAPOR IN THE ENERGY RANGE 1.5 TO 25 keV. Schlachter, A. S.; Loyd, D. H.; Bjorkholm, P. J.; Anderson, L. W.; Haeberli, W. (Univ. of Wisconsin, Madison). Phys. Rev., 174: 201-11(Oct. 5, 1968).

Charge-exchange collisions have been studied when He^+ ions with an energy in the range 1.5 to 25 keV are incident to Cs vapor. Measurements of the positive, neutral, and negative beam components after passage through the target were made as a function of the Cs target density at twelve energies. Over the entire energy range studied, the negative fraction was found to reach a maximum and then decrease with increasing target density. The maximum yield of He^- ions was measured to be (1.4 ± 0.1)%. The maximum occurred at a He^+ energy of 6 keV and a Cs target thickness of 5×10^{14} atoms/cm^2. Various cross sections relevant to the charge-exchange process were determined. At 10 keV the cross section for the production of a fast He atom from a He^+ ion incident on Cs is $(6.3 \pm 0.6) \times 10^{-15}$ cm^2, the value of the cross section for the production of a He^0 atom when a He^- ion is incident on Cs is $(1.0 \pm 0.3) \times 10^{-14}$ cm^2, and the value for the production of a He^- ion when a fast He^0 atom in the (1s) (2s) $^3S_1$ state is incident on Cs is $(1.4 \pm 0.4) \times 10^{-16}$ cm^2. (auth)

47801 SPIN-CHANGE IN $H-C^+$, $H-Si^+$ AND H-Al COLLISIONS. Smith, Francis J. (Queen's Univ. of Belfast). Mon. Notic. Roy. Astron. Soc., 140: 341-3(1968).

Spin-change cross sections are calculated for $H-C^+$, $H-Si^+$ and H-Al collisions taking account of the difference between the Σ and Π molecular states. It is shown that the results are almost a factor of two larger than those obtained neglecting this difference. (auth) (UK)

47802 ALPHA-PARTICLE IONIZATION IN ARGON-METHANE MIXTURES AND THE ENERGY DEPENDENCE OF THE ION PAIR-FORMATION ENERGY. Jesse, William P. (St. Procopius Coll., Lisle, Ill.). Phys. Rev., 174: 173-84(Oct. 5, 1968).

Experiments have been performed to investigate a long-standing discrepancy in the measurement of α-particle energies by the ionization method. The work of Jesse and his collaborators, carried out in pure argon with a total collection of ions, indicates a linear relation between ionization and α-particle energy for energies between 1 and 9 MeV. A different relation between ionization and α energy is observed in a large number of experiments with gridded pulse chambers; here, with collection of only the electronic component of the ionization in argon-methane (or argon-carbon dioxide) mixtures, an appreciable relative decrease of ionization is observed with decreasing α energy. Discussions in the literature have often attributed this difference between the two methods to the mode of collection of ions, whether total or electronic collection. The present experiments have investigated the

possibility that the discrepancy in the two types of experiment is due to the different media used—whether pure argon or argon–methane mixtures. To this end, a series of measurements was carried out for four α-particle energies, ranging from 1.58 to 5.3 MeV. For each of these particles, the ionization, relative to that in pure argon, was measured by a total collection method for a wide range of argon–methane mixtures. The results indicate a dependence on α energy in argon–methane mixtures considerably in excess of any possible dependence in pure argon. The variation with energy, moreover, in a mixture of argon with 6% methane is in good accord with past results obtained in gridded pulse chambers for this mixture. The present experiments would suggest therefore that the observed difference between the two methods would be the result, not of the method of ion collection, but of the different gaseous media used. (auth)

47803 ELECTRONIC TRANSITIONS IN SLOW COLLISIONS OF ATOMS AND MOLECULES. I. Chen, Joseph C. Y.; Watson, Kenneth M. (Univ. of California, San Diego, La Jolla). Phys. Rev., 174: 152-64(Oct. 5, 1968).

The semiclassical approximation is systematically applied to the study of electronic transitions in near-adiabatic collisions of atoms and molecules. The use of the eikonal approximation permits the coupled equations of scattering theory to be reduced to one-dimensional equations defined along classical trajectories. The theory for rearrangement collisions is developed into a form appropriate for use with the eikonal description of heavy-particle motion. (auth)

47804 MEASUREMENT OF ONE- AND TWO-ELECTRON-LOSS CROSS SECTIONS FOR He^- IONS IN H_2, He, AND Ne GASES (400 TO 1500 keV). Ryding, G.; Wittkower, A. B.; Rose, P. H. (High Voltage Engineering Corp., Burlington, Mass.). Phys. Rev., 174: 149-52(Oct. 5, 1968).

The destruction of He^- ions during passage through H_2, He, and Ne gas targets has been studied in the range of impact energies 400 to 1500 keV. He^- ions were formed by the charge exchange of positive He^+ ions. The cross sections for the loss of one (σ_{-10}) and two (σ_{-11}) electrons were determined from the rate of growth of the fast collision products He^0 and He^+ with increasing target gas density. (auth)

47805 EXCITATION OF THE n^1S STATES OF HELIUM BY PROTON IMPACT. Oldham, William J. B. Jr. (Manned Spacecraft Center, Houston, Tex.). Phys. Rev., 174: 145-8(Oct. 5, 1968).

The first Born-approximation cross sections for proton excitation of helium from the ground state to the n^1S (n = 4 to 7) states are calculated using a 53-term correlated ground-state wave function and 40-term correlated wave functions for the excited states. Generalized oscillator strengths for the respective transitions are also given. The results are compared with the only previous theoretical calculation and with existing experimental values. The agreement between theory and experiment is poor for absolute values, but the curves obtained from log σ vs log E plots have the same slope at large impact energies. (auth)

47806 TEMPERATURE DEPENDENCE OF THE ELECTRON–O_2^+-ION RECOMBINATION COEFFICIENT. Kasner, W. H.; Biondi, Manfred A. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 174: 139-44(Oct. 5, 1968).

The temperature dependence of the coefficient for the recombination of electrons with mass-identified O_2^+ ions has been determined from observations of the electron and ion decay rates in the afterglow following "single-pulse" microwave discharges in O_2–Ne, O_2–Ne–Ar, and O_2–Ne–Kr gas mixtures. Temporal mass analysis, utilizing multichannel signal-averaging techniques, shows similar decay rates for the electrons and for the O_2^+ ions over the major portion of the afterglow. The observed recombination coefficient, $\alpha(O_2^+)$, has a temperature dependence approximated by T_{gas}^{-1}, the values at temperatures of 205, 295, and 690°K being $(3.0 \pm 0.3) \times 10^{-7}$, $(2.2 \pm 0.2) \times 10^{-7}$, and $(1.0 \pm 0.2) \times 10^{-7}$ cm^3/sec, respectively. At the lower temperatures the dimer ion $O_2 \cdot O_2^+$ becomes significantly more important. Analysis of the data yields a coefficient of approximately 2.3×10^{-6} cm^3/sec for the recombination of this ion with electrons at a temperature of 205°K. (auth)

47807 CALCULATION OF THE ELECTRON BINDING ENERGIES AND X-RAY ENERGIES FOR THE SUPERHEAVY ELEMENTS 114, 126, AND 140 USING RELATIVISTIC SELF-CONSISTENT-FIELD ATOMIC WAVE FUNCTIONS. Tucker, Thomas C. (Oak Ridge National Lab., Tenn.); Roberts, Louis D.; Nestor, C. W. Jr.; Carlson, Thomas A.; Malik, F. B. Phys. Rev., 174: 118-24(Oct. 5, 1968).

Relativistic Hartree–Fock–Slater atomic wave functions have been calculated for the superheavy elements Z = 114 and 126. The calculations have been made both for the atom and for singly ionized states with holes in the K or L shells. A Wigner–Seitz boundary condition is used, and results for both point and finite nuclei are presented. From these solutions, binding energies and x-ray energies have been evaluated. Similar calculations have been made on Au and U, and have been compared with experiment so as to ascertain what degree of confidence one may have in these computations. A discussion is made of the importance of finite nuclear size in determining the K-shell binding energy, and a solution for element 140 was obtained to demonstrate the atomic stability in the present approximation of elements above Z = 137. Finally, the probability for finding an electron within the nuclear radius is given for each of the elements studied, and a brief discussion is given concerning the stability of the superheavy elements against electron capture. (auth)

47808 RELATIVISTIC STUDY OF KL_1L_1 AUGER TRANSITION PROBABILITIES. Chattarji, Dipankar; Talukdar, Benoy (Visva-Bharati Univ., Santiniketan, India). Phys. Rev., 174: 44-56(Oct. 5, 1968).

A relativistic expression for KL_1L_1 Auger transition probabilities has been obtained by using the solutions of the Biedenharn symmetric Dirac–Coulomb Hamiltonian. The interaction matrix element yields the well-known nonrelativistic result in the appropriate limit. Numerical results obtained for atoms having Z values between 72 and 80 are compared with earlier calculations. Relativistic effects are seen to play an increasingly important role as one goes to heavier atoms. (auth)

47809 MANY-BODY APPROACH TO THE ATOMIC HYPERFINE PROBLEM. I. LITHIUM-ATOM GROUND STATE. Chang, Edward S.; Pu, Robert T.; Das, T. P. (Univ. of California, Riverside). Phys. Rev., 174: 1-16(Oct. 5, 1968).

The Brueckner–Goldstone many-body perturbation method, previously utilized for calculations of atomic correlation energies and polarizabilities, has been extended to the study of the hyperfine structure. The correlation energy as well as the hyperfine coupling constant of the lithium atom are calculated and compared with the results of some earlier methods. The present method makes use of Feynman-like diagrams, which facilitate the evaluation of the importance of various physical effects. Analysis of the hyperfine diagrams shows that the difference between the experimental and the Hartree–Fock values is mainly accounted for by spin polarization, although correlation effects are by no means negligible. Our result of 2.887 au agrees very well with the experimental value of 2.9096 au. The excellent result for the total energy of −7.478 au, comparing with the corresponding experimental value of −7.47807 au, shows that the wave function is good overall, as well as in the region near the nucleus. (auth)

47810 MANY-BODY CALCULATION OF ATOMIC POLARIZABILITY: RELATION TO HARTREE–FOCK THEORY. Chang, Edward S.; Pu, Robert T.; Das, T. P. (Univ. of California, Riverside). Phys. Rev., 174: 16-23(Oct. 5, 1968).

The Brueckner–Goldstone perturbation method has been applied to the calculation of the dipole polarizability (α_d) and antishielding factor (γ_d) for the lithium-atom ground state. The complete set of states utilized is the same as those employed in earlier calculations of the hyperfine constant and correlation energy. Our results are $\alpha_d = 24.84$ Å^3 and $\gamma_d = 0.958$, as compared to a recent experimental value for $\alpha_d = 22 \pm 2$ Å^3 and $\gamma_d = 1.000$ from the Hellmann–Feynman theorem. The relationship between the Brueckner–Goldstone and the Hartree–Fock perturbation procedures is discussed with reference to specific physical effects. (auth)

47811 ACCURATE ATOMIC AND MOLECULAR WAVE FUNCTIONS WITHOUT EXCHANGE. Musher, Jeremy I. (Yeshiva Univ., New York); Silbey, Robert. Phys. Rev., 174: 94-103 (Oct. 5, 1968).

A perturbation-theoretic procedure is developed for obtaining the spatial function Φ_0 for the many-electron problem, from which the total wave function can be projected by the relation $\Psi = \Sigma_i \hat{D}_{i0}(r) D_{i0}(\sigma) \Phi_0(r) \chi_0(\sigma)$. This function is expanded in a perturbation series in which the Φ_0^i contains a sufficient set of pair symmetries of Φ_0 itself, such as in the Hartree nonantisymmetrized wave function for closed-shell atoms. When the expansion converges, the remaining symmetries are introduced exactly. The energy eigenvalue does not contain the usual "exchange" terms, since the zeroth-order Hamiltonian, unlike the Hartree–Fock H_0, has no degeneracies. Applications to interaction energies in molecular crystals and asymmetric wave functions are discussed briefly. (auth)

47812 PRESSURE SHIFTS OF HYPERFINE SPLITTING OF HYDROGEN AND TRITIUM IN ARGON. Brown, R. A.; Pipkin,

F. M. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 48-61(Oct. 5, 1968).

New measurements of the pressure shifts in argon of the hyperfine splitting of hydrogen and tritium are reported. A spin-exchange optical pumping technique was used to make these measurements. The fractional pressure shift (pressure shift in cps/mm Hg at 0°C divided by the hyperfine splitting in kMcps for hydrogen in argon) is -4.78 ± 0.03; the ratio of the fractional pressure shift for tritium to that for hydrogen is 1.007 ± 0.012; the temperature shift at constant density of the hydrogen hyperfine splitting is 0.012 ± 0.003 cps/°K mm Hg. This new value for the hydrogen pressure shift is then used to reanalyze the Yale data for the hyperfine splitting of muonium, under the hypothesis that the fractional pressure shift for muonium is the same as that for hydrogen. This gives for the muonium hyperfine splitting an alternative value of 4463.23(2) Mcps. This value of the muonium hyperfine splitting gives for the fine-structure constant α the alternative value $\alpha^{-1} = 137.0367(10)$. This value of α is compared with the values obtained from the hydrogen fine structure, hydrogen hyperfine structure, and the ac Josephson-effect determination of $2e/h$. (auth)

47813 MASS FORMULA FOR M = 0 AND M = 1 TOLLER FAMILIES. Di Vecchia, P.; Drago, F. (CNEN, Rome). Phys. Lett., 27B: 387-90(Aug. 19, 1968).

A method to derive the so-called mass formulas, based on analyticity alone, is presented. The simpler M = 0 case is discussed in some detail. The behavior of the residue functions is also studied; using the factorization theorem the Toller pole is reconstructed. The mass formula for M = 1 is given. (auth)

47814 CALCULATION OF RELATIVE INTENSITIES OF TRANSITIONS IN MUONIC LEAD. Srinivasan, V.; Sundaresan, M. K. (Carleton Univ., Ottawa). Nuovo Cim., 57B: 235-7 (Sept. 11, 1968).

In calculating the relative population of the different levels in heavier elements when a muon cascades down by means of Auger and radiative transitions after its capture, the effects of fine structure and finite nuclear size are not negligible and have to be incorporated into the program to produce reliable predictions. Since there has been little agreement in recent experimental and theoretical results on relative intensities in heavy elements like lead, it was decided to do a cascade calculation of the Eisenberg–Kessler type (Nuovo Cim., 19: 1195(1961)), starting from n = 14 and including fine-structure and finite nuclear effects. Results of these calculations are presented in this note. (L.M.T.)

47815 STUDY OF A NEW METHOD ALLOWING THE ORIENTATION AND ALIGNMENT OF VARIOUS EXCITED LEVELS OF ^{3}He. Laloee, Franck (CNRS, Paris). Compt. Rend., Ser. A and B, 267: 208-11(July 15, 1968). (In French).

An experiment is described in which various excited states of ^{3}He produced in a discharge and emanating from a nuclear orientation in the ground state, are aligned and oriented. (tr-auth)

47816 DETERMINATION OF THE HYPERFINE STRUCTURE CONSTANT A FOR ^{199}Hg IN THE 6^1P_1 LEVEL: HYPERFINE STRUCTURE OF THE 6^1P_1–8^1S_0 LINE (λ = 4916 A). Chartier, Jean-Pierre; Lecluse, Yves (CNRS, Caen, France). Compt. Rend., Ser. A and B, 267: 195-8(July 15, 1968). (In French).

The hyperfine structure constant A = 119.66 mk is found for ^{199}Hg in the 6^1P_1 level. Associating this value from results obtained from level crossing, one obtains for the 6^1P_1 level of mercury $g_J = 1.0163 \pm 0.0033$. (tr-auth)

47817 POTENTIAL ELECTRON EMISSION FROM THE (110) AND (111) FACES IN Mo MONOCRYSTALS. Arifov, U. A.; Rakhimov, R. R.; Dzhurakulov, Kh. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR, No. 3, 16-19(1968). (In Russian).

Data are presented on the electron-ion emission coefficient γ as a function of kinetic energy (E_0) during bombardment of the (110) and (111) Mo monocrystal faces by Ar^+ and He^+ ions in the energy range E_0 = 200 to 1200 eV. In this range, γ, for each Mo monocrystal face and for each type of ion was different, as well as the variational behavior $d\gamma/de_k$ vs. $e_k E_0$, where e_k is the kinetic energy of the emitted electron. (R.V.J.)

47818 PHOTOELECTRIC CROSS-SECTIONS OF GAMMA-RAYS IN ALLOYS. Rao, P. V. Ramana; Visweswara Rao, V.; Parthasaradhi, K.; Rama Rao, J. (Andhra Univ., Waltair, India). Curr. Sci. (India), 37: 524-5(Sept. 20, 1968).

Photoelectric cross section measurements were made for platinum–rhodium alloys and for each single metal. The measurements are compared. (M.O.W.)

47819 AUGER MECHANISM OF CHARACTERISTIC LOSSES OCCURRING IN ATOMIC COLLISIONS. Kishinevskii, L. M.; Parilis, E. S. (Inst. of Electronics, Tashkent). Zh. Tekh. Fiz., 38: 760-3(Apr. 1968). (In Russian).

This is a continuation of earlier work (Dokl. Akad. Nauk Uzb. SSR, 9: 10(1966)) dealing with multiple ionization produced when fast atoms collide with ions of the same substance and the energy losses accompanying such a process. The purpose of the present investigation was to show that the mechanism described in the earlier paper, wherein half of the emitted electrons are produced by the Auger effect, can explain the existence of discrete structure of the inelastic energy losses with definite characteristic values. A table listing the characteristic losses for Ar^+–Ar, Ar–Ar, Ne^+–Ne, and Ne^+–Ar collisions is presented. The calculated results do not always agree with the experimental data and the reasons for the discrepancies are briefly discussed. It is possible that other mechanisms besides the Auger mechanism play a significant role in multiple ionization by ion impact. (ATD)

47820 ON THE FORMATION OF HIGHLY EXCITED ATOMS IN COLLISIONS BETWEEN ELECTRONS AND CO_2O_2 AND N_2 MOLECULES. Kupriyanov, S. E. (Physical-Chemical Scientific-Research Inst., Irkutsk, USSR). Zh. Eksp. Teor. Fiz., 55: 460-8(Aug. 1968). (In Russian).

It is shown that highly excited C*, O*, and N* atoms are produced as a result of excitation of high Rydberg states in CO, O_2, and N_2 molecules, which converge to the respective limits for singly and doubly charged ions of the initial molecules. The molecular ions CO^+ and O_2^+ are produced in collisions between highly excited oxygen atoms and CO or O_2 molecules. The formation of long-lived highly excited states of CO, O_2, and N_2 molecules has not been observed. The cross sections for scattering of highly excited O* and C* atoms colliding with CO molecules are respectively 2 and 1.5×10^{-13} cm^2. (auth)

47821 CALCULATIONS OF INTENSITY OF β EMISSION BACKSCATTERING. Cretu, T.; Macarie, Gh. (Polytechnic Inst., Bucharest). Stud. Cercet. Fiz., 20: 303-9(1968). In Rumanian).

Calculation of the backscattering radiation intensity is made on the assumption that the interaction between incident β particles and matter is of the Mott–Massey type. All the calculations are made in Born's approximation. The fact that the final results indicate the dependence of the counting rate on Z (atomic number) and d (layer-depth) already mentioned experimentally by other authors, allows one to draw the conclusion that, at least qualitatively, the choice of the differential interaction section of the Mott–Massey type describes the phenomenon of β-radiation backscattering in a satisfactory manner. It is attempted to give a calculus method which takes into account the nature of the β-radiation interaction with the backscattering matter. (auth)

47822 EXCITATION CROSS SECTION FOR THE He ATOM IN SLOW COLLISIONS WITH He. Kvlividze, V. A. (Inst. of Nuclear Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 654-6 (Aug. 1968). (In Russian).

The cross section for transition to the $2s^1S_0$ state of the He atom in collisions with He is calculated assuming the existence of a region of pseudo intersection of the terms at small internuclear distances. The term separation in the pseudo-intersection region ($R = 1.1\ a_0$) is 2.84 eV. For relative energies of 100 to 500 eV in the laboratory system, the cross section is 2×10^{-17} cm^2. (auth)

47823 RELATIVISTIC ATOMIC PHOTOEFFECT FROM THE K SHELL NEAR THE THRESHOLD. Mikhailov, A. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 55: 625-34(Aug. 1968). (In Russian).

Analytic expressions for the total and differential cross sections for the atomic K shell photoeffect and for seven nonzero polarization correlations between the incident photon and emitted electron are derived. The expressions are obtained by the formalism developed by Pratt et al. and for photon energies close to the K shell ionization energy. The matrix element is calculated with exact relativistic functions. Terms $\sim\alpha^6Z^6$ are neglected in the expression for the total cross section and terms $\sim\alpha^5Z^5$ in the angular distribution. The correlations are calculated with a relative accuracy of the order of α^2Z^2. The results are valid for photon energies $k - I_b < m\alpha^2Z^4/2$ (k is the photon energy, and I_b the K-electron binding energy). Screening is not taken into account. (auth)

47824 REACTIONS OF LOW-ENERGY O^- IONS WITH D_2 AND H_2. Martin, J. D.; Bailey, T. L. (Univ. of Florida, Gainesville). J. Chem. Phys., 49: 1977-8(Aug. 15, 1968).

Total cross sections for the ion–molecule reactions $O^- + D_2 = OD^- + D$ and $O^- + H_2 = OH^- + H$ were measured over the laboratory primary-ion kinetic-energy ranges of 1.5 to 69 eV and 2.7 to 119 eV, respectively. These experiments were carried out in a fixed 0° scattering-angle tandem mass spectrometer. The cross

sections for both reactions rise very steeply from apparent onsets in the manner typical of endothermic processes. The validity and the consequences of the assumption that the apparent onsets are true energetic thresholds are considered briefly. The cross sections $\sigma(OD^-)$ and $\sigma(OH^-)$ at energies above about 30 eV are approximately the same, but $\sigma(OD^-)$ becomes much larger than $\sigma(OH^-)$ at lower energies. This discrepancy lies well outside the experimental error and is believed to be a true isotope effect. (A.G.W.)

47825 VIBRATIONAL EXCITATION AND FRAGMENTATION OF MOLECULAR HYDROGEN FROM SLOW K^+ COLLISIONS. Dittner, Peter F.; Datz, Sheldon (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 49: 1969-70(Aug. 15, 1968).

Inelastic energy losses arising from knock-on collisions of K^+ with H_2 and D_2 molecules were determined by time-of-flight measurements of the K^+ velocity following collision with a target molecule. Initial center-of-mass energies ranged from 2.5 to 10 eV for H_2 and from 10 to 30 eV for D_2. Inelastic energy losses below the dissociation limit correspond to vibrational excitation of the molecule. Above ~20 eV the inelastic loss exceeds the molecular dissociation limit, and the slope of the loss curve increases. The peak shape remains relatively sharp, but a second energy-loss peak appears, which increases in relative population with increasing energy. The higher peak is ascribed to the dissociation of a D_2 molecule accompanied by electronic excitation of a D atom. (A.G.W.)

47826 CHARGE TRANSFER BETWEEN POSITIVE ALKALI IONS AND ATOMS. Gentry, W. R.; Lee, Yuan-tseh; Mahan, Bruce H. (Univ. of California, Berkeley). J. Chem. Phys., 49: 1758-62(Aug. 15, 1968).

The total cross sections for resonant charge exchange have been measured as a function of energy in the range from 10 to 500 eV for the Cs^+-Cs, Rb^+-Rb, and K^+-K systems. The agreement with certain data obtained at higher energies for these systems and with theoretical cross sections of Smirnov is satisfactory. (auth)

47827 SEMICLASSICAL THEORY OF INELASTIC SCATTERING: DIAGONALIZATION OF THE PHASE SHIFT MATRIX. Cross, R. J. Jr. (Yale Univ., New Haven). J. Chem. Phys., 49: 1753-7(Aug. 15, 1968).

The previously obtained semiclassical phase shift matrix is diagonalized in the classical limit by a simple transformation. In the diagonal representation, the various scattering expressions can be simplified appreciably by the method of stationary phase to resemble the semiclassical expressions for elastic scattering. Analogous equations are obtained for the scattering angle and the collision lifetime. A perturbation method is derived to cover deviations from the classical and sudden-approximation limits. (auth)

47828 QUANTUM THEORY OF (H,H_2) SCATTERING: TWO-BODY POTENTIAL AND ELASTIC SCATTERING. Tang, K. T.; Karplus, M. (Columbia Univ., New York. Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 49: 1676-92(Aug. 15, 1968).

Effective two-body interaction potentials for elastic and reactive, H, H_2 scattering have been constructed from a semiempirical three-body potential-energy surface. Two limiting approximations were used: in one, (V_u^0), the molecule is unperturbed by the incoming atom, and in the other, (V_a^0), the molecule adiabatically follows the incoming atom. Since van der Waals contributions were not included in the three-body surface, a modified two-body potential, (V_m^0), which included long-range $(-C/R^6)$ attractive terms, was also considered. Elastic differential and total cross sections were calculated for energies between 0.025 and 1.0 eV and compared with the available measurements. Although more experimental data are needed for a definitive test, the two-body potential (V_m^0) appears to give reasonably accurate results. As the coefficient C is very small for H, H_2, the main effect of the van der Waals term in V_m^0 is to reduce the total cross section. Only small differences are found in the elastic scattering from the potentials V_u^0 and V_a^0; this contrasts sharply with the reactive scattering results. (auth)

47829 FLUX AND SPEED DISTRIBUTIONS OF MOLECULAR BEAMS AFTER SCATTERING BY METAL SURFACES. Fisher, S. S.; Hagena, O. F.; Wilmoth, R. G. (Univ. of Virginia, Charlottesville). J. Chem. Phys., 49: 1562-71(Aug. 15, 1968).

High-intensity, nearly monoenergetic, nozzle-type molecular beams together with a sensitive time-of-flight detection system have been employed to study the scattering of argon and nitrogen from polycrystalline nickel and stainless-steel surfaces. The apparatus has allowed the precise measurement of essentially complete flux and speed distributions of the particles reflected in the plane of the incident beam and the target normal. Incident energy (0.065 to 0.24 eV), surface temperature (300 to 1000°K), angle of incidence, and angle of reflection have been varied. At room temperature, prior to any heat treatment in the apparatus, these unpolished targets exhibit essentially the classical diffuse scattering pattern with almost complete thermal accommodation. With the Ni surfaces tested, outgassing and annealing at approximately 900°K resulted in highly lobular scattered flux patterns for target temperatures between 550 and 950°K. These patterns are accompanied by a marked angular variation of the reflected-particle speed distribution, which differs the more from the fully accommodated Maxwellian distribution the farther the angle of scattering is from the surface normal. These lobular flux patterns are in qualitative agreement with the predictions of the so-called "hard-cube" model, but for the scattered particles the angular variation of the mean speed is smaller, and the angular variation of the relative spread in kinetic energies is greater, than predicted. Stainless steel exhibits similar but less pronounced scattering lobes accompanied by somewhat subdued angular variations of the speed distributions. (auth)

47830 OBSERVATION OF LAMB SHIFTS BY QUANTUM BEATS. Hadeishi, Tetsuo (Univ. of California, Berkeley). Phys. Rev. Lett., 21: 957-61(Sept. 30, 1968).

The technique which was used previously to observe quantum beats due to coherent electron-impact excitation of Zeeman magnetic sublevels is extended to the observation of the Lamb shift in the n = 4 state of $^4He^+$. The quantum beats in this experiment are due to temporal variations of the fluorescent light. Series' theory is extended and the first experimental observation of the effect predicted by Series is reported. (auth)

47831 LIFETIMES OF METASTABLE STATES OF He-LIKE IONS. Senashenko, V. S.; Teku, B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 3, 120-2(May-June 1968). (In Russian).

Lifetimes of the 2^1S metastable states of helium-like ions from He to Ne^{8+} were calculated and lifetimes of the 2^3S states for these ions were estimated. The curves of lifetimes of He and Li^+. The states as functions of Z are given. The obtained magnitudes τ are in agreement with published data on lifetimes of He and Li^+. The dependence of τ on Z differs from a simple law $1/Z^6$, accomplished without screening; the difference is considerable in case of small Z. Lifetimes of the 2^3S states were evaluated in relation to two-photon decay. The magnitude τ of these states is in the range 9.3×10^4 to 3.4×10^{-6} sec for He to Ne^{8+}. Without screening the lifetime of the triplet state in relation to Z is reduced according to the law $1/Z^{12}$. The magnitude of τ for the metastable state 2^1S of N^{5+} to Ne^{8+} ions is within the range of 10^{-6} to 10^{-8} sec. (R.V.J.)

47832 MESON CAPTURES IN SOLIDS. Au-Yang, M. Y.; Cohen, Marvin L. (Univ. of California, Berkeley). Phys. Rev., 174: 468-76(Oct. 10, 1968).

A calculation was made of the Z dependence of the atomic capture of negative mesons in simple compounds. A self-consistent Fermi–Thomas potential was used to solve the resulting Schrödinger equation describing the meson in the solid. The results give better agreement with experiment than the Fermi–Teller linear Z law. The observed oscillatory behavior of the capture ratio as a function of Z for oxides is qualitatively explained. (auth)

47833 ELECTRIC FIELD DEPENDENCE OF POSITRONIUM FORMATION IN MATTER. Brandt, Werner; Feibus, Howard (New York Univ., N. Y.). Phys. Rev., 174: 454-9(Oct. 10, 1968).

Positronium (Ps) can be formed whenever positrons, on slowing down in a substance, pass through an Ore gap, i.e., a range of energies, just below the ionization threshold of the substance, of width comparable to the Ps binding energy. The time evolution of the energy distribution of the positrons below the ionization threshold in an external electrostatic field was studied and it was found: (1) the field induces diffusion out of the Ore gap, which decreases Ps formation; and (2) the overall heating effect of the field on the positrons increases Ps formation. Depending on the magnitude of the relevant cross sections, (1) can outweigh (2), at small fields, and cause a significant decrease in the Ps formation. At field strengths larger than a characteristic value, (2) becomes the dominant effect. In this way measurements of the field dependence of Ps formation can give access to the cross sections for Ps formation and for positron-energy loss and scattering in matter. (auth)

47834 EXCITATION CROSS SECTION FOR SOME OF THE DOUBLY IONIZED STATES OF ARGON, NEON, AND KRYPTON BY FAST ELECTRONS. Koozekanani, S. H. (Ohio State Univ., Columbus). J. Appl. Phys., 39: 4799-4806(Sept. 1968).

Excitation cross section for the doubly ionized states of argon, neon, and krypton has been found for the process where a fast-moving electron impinges upon a neutral atom, causing the neutral atom to go from l^N to $(l^{N-3}-nl'')$ in a very short time compared to the relaxation time of the ion. These calculations are

useful when one is interested to know the excited states in which the ion is left after the atom loses some of its electrons and becomes ionized. (auth)

47835 SPUTTERING OF SINGLE-CRYSTAL COPPER BY 400- AND 600-keV ARGON IONS. Higgins, T. B.; Olson, N. Thomas; Smith, Harold P. Jr. (Univ. of California, Berkeley). J. Appl. Phys., 39: 4849-50(Sept. 1968).

Sputtering yield and angular distribution measurements were made using a radioactive target and mosaic collector technique. The argon ions of 400- or 600-keV energy were delivered at normal incidence parallel to the ⟨100⟩ direction, in 3×10^{-7} torr vacuum. The total yield was found to be 0.93 and 0.85 at 400 and 600 keV, respectively. An analytic function with a cosine turn (diffuse background) and a Gaussian term (preferred emission) in the ⟨110⟩ direction was fitted to the data. It is concluded that the preferred emission is essentially a surface phenomenon. (D.L.C.)

47836 CALCULATION OF SLATER-TYPE ONE-ELECTRON FUNCTIONS. EXCHANGE APPROXIMATION. Gaspar, R.; Erdoes-Gyarmati, G.; Tamassy-Lentei, I. (Kossuth Lajos Univ., Debrecen, Hungary). Acta Phys. Acad. Sci. Hung., 24: 173-98 (1968).

With the aid of a universal potential, Slater-type functions are calculated. Rasetti's method was used for the determination of the effective principal quantum numbers and the screening constants. The one-electron energy eigenvalues are also determined as a function of the atomic number. Calculation shows that the exchange potential shifts the energy eigenvalues and the other parameters in the correct direction. (auth)

47837 RELATIVISTIC EVALUATION OF INTERNAL DIAMAGNETIC FIELDS FOR ATOMS AND IONS. Feiock, F. D.; Johnson, W. R. (Univ. of Notre Dame, Ind.). Phys. Rev. Lett., 21: 785-6(Sept. 16, 1968).

Diamagnetic shielding factors for a number of atoms and ions are evaluated using relativistic electron theory in the Hartree–Fock–Slater approximation. The results agree well with previous nonrelativistic values for light atoms but include relativistic corrections which rise to 62% for Hg. (auth)

47838 π-MESIC 4f–3d AND 5g–4f X-RAYS. Schmitt, H. (CERN, Geneva. Max-Planck-Institut fuer Kernphysik, Heidelberg. Univ., Karlsruhe, Ger.); Tauscher, L.; Backenstoss, G.; Charalambus, S.; Daniel, H.; Koch, H.; Poelz, G. Phys. Lett., 27B: 530-1(Sept. 16, 1968).

Pionic 4f–3d x rays from In, I, Cs, La, and Pr, and 5g–4f x rays from Ta, Pt, Au, Hg, Tl, ^{206}Pb, Pb, and Bi have been measured with Ge detectors. Energies and widths were determined, taking quadrupole splitting into account whenever necessary. (auth)

47839 ELASTIC SCATTERING OF SLOW ELECTRONS BY A Bi ATOMIC BEAM. Haug, R. (Johannes Gutenberg-Univ., Mainz). Z. Phys., 215: 350-55(1968). (In German).

The angular distribution of electrons elastically scattered by bismuth atoms has been investigated in the angular range from 30 to 155° and with electron energies between 5 and 1200 eV. Theoretical data available for energies above 100 eV are in good agreement with experiment. (auth)

Cosmic Radiation

47840 (N-68-23752) IMPROVED MODEL FOR COSMIC RAY PROPAGATION. Noerdlinger, Peter D. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Apr. 1968. 21p. (NASA-CR-94593). CFSTI.

A model for cosmic-ray propagation derived by Jokipii is modified to take into account particle mirroring. This removes the unreasonable sensitivity of the original theory to the extreme high frequency end of the interplanetary magnetic field power spectrum P(f). It is then possible to relate the diffusion coefficient for particles of known velocity and rigidity to a limited portion of the field spectrum. (auth) (STAR)

47841 (N-68-24668) THE INTER-RELATIONSHIP OF COSMIC-RAY ANISOTROPIES AND THE INTERPLANETARY MAGNETIC FIELD. McCracken, K. G.; Rao, U. R.; Ness, N. F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov. 1967. 19p. (NASA-TM-X-63208; X-612-67-584). CFSTI.

The direction of the cosmic-ray anisotropy during solar proton events and the concurrent direction of the interplanetary magnetic field vector are compared using data obtained in 1966 by the Pioneer VI spacecraft. It is shown that the nonequilibrium cosmic-ray anisotropy (normally observed to exhibit an amplitude in the range 20 to 50%) is field aligned, while the equilibrium anisotropy (normally observed to exhibit an amplitude in the range 5 to 15%) is independent of the direction of the magnetic field vector. Two anomalous proton events during which pronounced anisotropies were observed with their maximum cosmic-ray fluxes directed towards the Sun are discussed. It is shown that during these proton events there were synchronous reversals of 180° in the direction of the magnetic field vector, and the cosmic-ray anisotropy direction, in association with the passage of a magnetic sector boundary past the spacecraft. These observations are interpreted as possible evidence for their being a complex loop in the magnetic field. (auth) (STAR)

47842 POSSIBLE ANISOTROPY OF SOLAR MODULATION AND THE LOW ENERGY COSMIC RAY SPECTRA. Apparao, M. V. K. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A, 67: 262-6(May 1968).

It is suggested that it is possible that solar modulation is anisotropic with respect to helio-latitude. This is suggested from the elliptical shape of the solar corona at minimum as seen visually and by radio measurements. This elliptical shape near the Sun suggests a possible nonsphericity of the modulating region as well as nonisotropicity of the velocity of solar wind and the nature of magnetic irregularities. (W.D.M.)

47843 COSMIC-RAY EFFECTS OF ATMOSPHERIC, GEOMAGNETIC AND INTERPLANETARY ORIGIN. Lindgren, Stig Torgny. Uppsala, Univ., Uppsala, 1967. 12p.

Thesis.

A review is given of the effects of the geomagnetic field and the atmosphere on cosmic rays. Problems of the mass absorption of the nucleon component and the intensity variations including the amplitude and phase characteristics of the daily variation averaged over years and sun rotation periods, anomalous types of anisotropy, long-term spectral changes in the diurnal anisotropy, the structure of a cosmic storm, and storm-time increase effects are discussed. Many variations are related to transient disturbances in the quiet-day plasma flow from the sun. It is well established that storm plasma tends to compress the magnetosphere and generate enhanced ring currents. (J.F.P.)

47844 GRADIENT OF COSMIC-RAY INTENSITY PERPENDICULAR TO THE ECLIPTIC PLANE. Kane, R. P. (Physical Research Lab., Ahmedabad, India). Nuovo Cim., 57B: 36-42 (Sept. 11, 1968).

Cosmic-ray gradients perpendicular to the ecliptic (cross gradients) can be estimated, in principle, from the seasonal variation of cosmic-ray intensity, because the earth deviates from the solar equatorial plane by about ±7° heliolatitude (equivalent to ±1/8 au) during a year. However, such estimates can be greatly vitiated by long-term cosmic-ray changes specially when these are nonlinear. Neutron monitor data for the period 1958 to 1967 are critically examined for such an effect. The long-term changes were tolerably linear only during September 1963 to May 1965 and analysis for this period yields an extrapolated cross gradient less than (4 ± 2)%/au. For other periods the method is unreliable. The method is applicable only to heliolatitudes within ±7° corresponding to distances of ±1/8 au and hence gives no information for regions beyond. (auth)

47845 DIURNAL VARIATION OF VLF POWER SPECTRAL DENSITY BETWEEN 100Hz AND 20 kHz AT BYRD STATION, ANTARCTICA. Morozumi, Henry M. (General Electric Co., Syracuse, N. Y.). Planet. Space Sci., 16: 1069-70(Aug. 1968).

The diurnal variation of the vlf power spectral density was determined by scaling the vlf noise recorded on a Panoramic Sonic Analyzer, and presented on a contour map. The upper profile of the amplitudes of vlf noise was scaled at 15 selected frequencies. (UK)

47846 ON THE VARIATIONS OF COSMIC RAY μ-MESON INTENSITY DURING RAPID PRESSURE VARIATIONS AND ABOUT THE APPLICABILITY OF DUPERIER'S MODEL. Kangas, J.; Kananen, H.; Kokkoniemi, J. (Univ. of Oulu, Finland). Geophysica, 9: 321-6(1967).

Secondary cosmic μ-mesons registered on the ground are produced throughout the atmosphere; the average production level is about 150 mbar. The μ mesons lose their energy through ionization; therefore, the thickness of the atmosphere has an effect on their absorption. Further, μ mesons have a finite lifetime, and the height of the production level also influences the μ-meson ground-level intensity. As the temperature controls the free path of μ mesons, the atmospheric effects on the meson intensity registered on the ground can be represented by the Duperier formula. The studies of Tanskanen [Ann. Acad. Sci. Fenn. A VI: 185 (1965)], who reported that in the μ-meson intensity there is a hysteresis phenomenon during rapid pressure variations, were

confirmed, and an effort was made to explain the observed loop-like variations by the changes in the structure of the atmosphere. In this study the applicability of the Duperier model was confirmed, and some success in using neutron monitoring data to describe primary variations in μ-meson intensity was attained. When long-period cosmic-ray variations are studied, short periods with geomagnetic disturbances are often neglected. In accordance with the present results, periods with very rapid pressure variations should also be disregarded, if the data have been corrected only for barometric pressure. (BBB)

47847 IMPLICATIONS OF THE SMALL RADIAL ANISOTROPY OBSERVED IN THE 7.5- TO 45-Mev COSMIC RAYS. Forman, Miriam A. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res., 73: 5783-5(Sept. 1, 1968).

It is concluded that the small magnitude of the anisotropy δ_r reported by Rao et al., (1967) is consistent with the large increase in cosmic-ray density between 1 and 1.56 AU reported by O'Gallagher (1967) only if the cosmic-ray density gradient is increasing rapidly at 1 AU with distance from the Sun, as Jokipii and Parker (1968) conclude, and/or if the magnitude of the anisotropy itself at 1 AU is increasing rapidly with distance from the Sun. (W.D.M.)

47848 COSMIC-RAY DIFFUSION TENSOR AND ITS VARIATION OBSERVED WITH MARINER 4. Jokipii, J. R. (Univ. of Chicago); Coleman, Paul J. Jr. J. Geophys. Res., 73: 5495-5503(Sept. 1, 1968).

Magnetic-field power spectra computed from data obtained with the Mariner 4 spacecraft were analyzed to determine the cosmic-ray diffusion tensor in interplanetary space. The diffusion tensor was computed for particles with rigidities R = Pc/z from 0.1 to 10 GV, for two heliocentric ranges, one near the orbit of Earth and the other near the orbit of Mars. At rigidities $\lesssim 1$ GV, the parallel diffusion coefficient was approximately $K_{\parallel} \sim 5 \times 10^{21} R^{\frac{1}{2}} \beta$ cm^2 sec^{-1} at ~1 AU. It is smaller at r ~ 1.5 AU. The computed diffusion tensor leads to a cosmic-ray gradient as a function of rigidity that is consistent with the gradient determined from cosmic-ray data by O'Gallagher and Simpson. Finally, cross correlation of the cosmic-ray counting rate with the level of magnetic fluctuations (amplitude of the power spectrum) shows that the periods of high field variance are followed by depressed counting rates. (auth)

47849 SOME ASPECTS OF ATMOSPHERIC EFFECTS ON THE COSMIC RAY μ-MESON INTENSITY. Kokkoniemi, J.; Kananen, H.; Kangas, J. (Univ. of Oulu, Finland). Geophysica, 9: 313-19(1967).

The μ-meson intensity of cosmic radiation was registered with the cubical meson telescope at the Univ. of Oulu during the year 1965. Theoretical aspects of μ-meson production are discussed, and the Duperier model was applied to the recorded data using a linear multiple correlation and regression analysis. Calculations were carried out on an electronic computer (type Elliot 803), using as reference levels the pressure levels of 400, 300, 200, 150, and 100 mbar. The partial pressure coefficient α, the height coefficient β, the positive temperature coefficient γ, and the total correlation coefficient R, of the model used were calculated for every month of the year. The total correlation coefficient was smallest in summer. The partial pressure coefficient varied most strongly in summer. On the other hand, it was nearly constant in 1964, but in 1965 there was an evident change. In the beginning of the year 1965, α was -0.12%/mbar and at the end of the year -0.13%/mbar. Whether α will vary during the period of solar activity in the same manner as the pressure coefficient of neutron monitoring will be of interest. The temperature coefficient depended greatly on the pressure of the reference level. It was greater for the 100-mbar level than for the 150-mbar level. The value of γ decreased with increasing pressure level. The height coefficient had its minimum in summer. No clear periodicity in the variations of the coefficients was seen because the period studied at Oulu was too short. Attempts to obtain better correlation coefficients using neutron-monitor data to eliminate primary variations were not successful. (BBB)

47850 USE OF CYLINDRICAL GAS-DISCHARGE COUNTERS FOR MEASURING THE ABSOLUTE INTENSITY OF COSMIC RAYS. Salimzibarov, R. B.; Skryabin, N. G.; Shafer, Yu. G. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 116-19(1968).

Translated from Geomagn. Aeron., 8: 146-50(1968).

Formulas are presented for computing the geometric factors of counter telescopes and single counters when the radiation recorded has an isotropic and a nonisotropic distribution. The formula for a counter telescope consisting of two identical cylindrical counters with mutually parallel axes, located one above the other, allows fully for the effect of end-window counters and, in a limiting case, it leads to an expression for the geometric factor of a single counter. It is shown that it is possible to determine the variations of the angular distribution function of cosmic radiation from the readings of two vertically and horizontally positioned counters or from the readings of two counter telescopes with different spacing between the axes of the outermost counters. (auth)

47851 SECULAR VARIATIONS OF COSMIC-RAY INTENSITY. Chirkov, N. P., Filippov, V. A.; Shafer, G. V. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 130-2(1968).

Translated from Geomagn. Aeron., 8: 163-5(1968).

Data on the secular variations of cosmic-ray intensity from 1953 to 1956 from observations with an ionization chamber at Yakutsk are presented, along with solar activity data. (TSS)

47852 PLANETARY DISTRIBUTION OF THE BAROMETRIC COEFFICIENTS OF THE NEUTRON COMPONENT OF COSMIC RAYS DURING THE IQSY. Dorman, L. I.; Rogava, O. G.; Shatashvili, L. Kh. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow. Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 132-4(1968).

Translated from Geomagn. Aeron., 8: 166-7(1968).

Results of the determination of the barometric coefficients of the neutron component of cosmic rays from the data of the global network for the IQSY period (1964 to 1965) are presented. A clear latitude dependence of the coefficients is exhibited. (TSS)

47853 SECULAR MODULATION OF GALACTIC COSMIC RAYS IN INTERPLANETARY SPACE. Charakhch'yan, A. N.; Charakhch'yan, T. N. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 23-7(1968).

Translated from Geomagn. Aeron., 8: 29-35(1968).

The results of stratospheric measurements of the secular modulation of galactic cosmic rays are analyzed. The relation of this phenomenon to the 11-year solar activity cycle is examined. (auth)

47854 PENETRATION OF SOLAR PROTONS AND ALPHAS TO THE GEOMAGNETIC EQUATOR. Lanzerotti, L. J. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett., 21: 929-33 (Sept. 23, 1968).

Simultaneous spectral observations of low-energy solar particles in interplanetary space and in the magnetosphere on the equator strongly imply that these particles have essentially free access to the outer magnetosphere through a very effective diffusion mechanism which preserves the spectral shapes and the flux magnitudes. These observations further imply that measurements of solar-particle arrival time over the polar caps are not sufficient to distinguish between open or closed magnetosphere models. (auth)

47855 DIURNAL VARIATION OF COSMIC RAYS AND ITS CONNECTION WITH SOLAR ACTIVITY. Vladimirskii, B. M.; Pankratov, A. K.; Stepanian, A. A. Izv. Krym. Astrofiz. Observ., 35: 222-42(1966). (In Russian).

The mean amplitudes and phases of the first harmonic of the diurnal variation of cosmic rays have been determined from IGY data by the method of directional intensities suggested by Stepanian. The advantages and disadvantages of this method as compared to others described in the literature are analyzed in detail. It is shown that, in addition to the principal afternoon zone of stable phases in the diurnal variation, there is another region of relatively stable phases in the interval 0000 to 0400 h local time. Phase jumps at 180° and their connection with magnetic activity have been detected. It was found that the phase jumps occur apparently at the Kp index minimum or during magnetic storms. Two types of magnetic storms, which differ in the character of behavior of the diurnal variation, have been detected. One group is connected with an increase of diurnal variation before SC and the other after. The relation between magnetic storm effects on diurnal variation and the longitude of the corresponding solar flare is studied. The variation curve of the diurnal variation after type IV radio bursts, which were not accompanied by magnetic storms with SC, is obtained. Two amplitude increases are observed: on the 1st and 3rd day after a burst. (Meteorol. Geoastrophys. Abstr.)

47856 GEOPHYSICAL PROCESSES AND COSMIC-RAY VARIATIONS DURING A MAGNETIC STORM AT VOSTOK STATION. Kazarin, V. A.; Kozin, I. D.; Taylor, D. H. Sov. Antarct. Exped. Inform. Bull., 6: 404(May 1968).

A magnetic storm began at Vostok Station at 20 hr 30 min

(Greenwich time) on August 29, 1966, and ended at 16 hr 30 min on September 4. This storm had active periods on August 30 and September 3 to 4, during which there were appreciable Forbush decreases in cosmic-ray intensity. Concomitant geophysical phenomena included the lack of transmission of radio waves between Vostok and Mirny and the absorption of cosmic noise in the ionosphere, which reached 30 db at 20 MHz. Analysis of the variations of the neutron component of cosmic rays, after corrections for the barometric effect, showed that cosmic-ray intensity began to decrease 2 hr after the beginning of the magnetic storm. A second, more pronounced decrease in intensity began at 14 hr 00 min on August 30. The duration of the rapid decrease was 7 hr. During this period the intensity dropped 6.4% of the value before the disturbed period. At midnight on August 31, during the recovery of the Forbush effect, there was a new decrease in the intensity of the neutron component which reached 11.6% at 11 hr 00 min. Then restoration of cosmic-ray intensity began with reappearance of Forbush effect, the strongest of which was recorded on September 4. The last resurgence of cosmic-ray intensity began at the end of the magnetic storm and ended on September 10. The average hourly intensity of the neutron component of cosmic rays, reduced to a mean barometric pressure of 620 mb, was 940 counts/hr. (BBB)

47857 OBSERVATIONS ON THE COSMIC RAY ANGULAR DISTRIBUTION UNDERGROUND AT 1500 hg/cm^2 (KOLAR) AND THE QUESTION OF MUON PRODUCTION IN THE TeV ENERGY REGION. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; Kawakami, S.; Kino, S.; Miyake, S. Phys. Lett., 27B: 535-8(Sept. 16, 1968).

Measurements on the angular distribution of cosmic-ray muons at 1500 hg/cm^2 (Kolar) are presented: these relate to muons with energies ≥500 GeV. These observations are fully consistent with the picture that pions and kaons together are wholly responsible for the production of muons at these energies. (auth)

47858 EFFECT OF PHOTOMESON PRODUCTION BY THE UNIVERSAL RADIATION FIELD ON HIGH-ENERGY COSMIC RAYS. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev. Lett., 21: 1016-18(Sept. 30, 1968).

A detailed calculation was made of the lifetime and attenuation mean free path of high-energy cosmic rays against photomeson production. The calculation utilized the results of recent laboratory studies of photomeson production which have become available since 1966. The implications of the result are discussed. (auth)

47859 SEARCH FOR MASSIVE PARTICLES IN THE COSMIC RADIATION AT SEA LEVEL. Franzini, P.; Shulman, S. (Columbia Univ., New York). Phys. Rev. Lett., 21: 1013-15(Sept. 30, 1968).

No evidence was found for the existence of long-lived, massive particles in the cosmic radiation at sea level. The experimental limit for masses above 2 BeV/c^2 is 2.2×10^{-8} particles (cm^2 sr sec)$^{-1}$. (auth)

47860 PHYSICAL SIGNIFICANCE OF THE UNUSUAL WORLDWIDE FLUCTUATIONS OF COSMIC-RAY INTENSITY ON JULY 14-15, 1961. Ahluwalia, H. S.; Zubieta, M.; Schreier, M. (Laboratorio de Fisica Cosmica, La Paz, Bolivia). Solar Phys., 4: 453-73(Aug. 1968).

The characteristics of the unusual worldwide fluctuations of cosmic-ray intensity on July 14–15, 1961 were examined, using corrected hourly data from the global network of neutron and meson detectors. A careful study of the associated solar, interplanetary, and geophysical phenomena has also been made. These investigations lead to recognition of the dominant role played by the interplanetary magnetic field inhomogeneities (IMFI) in modulating galactic cosmic-ray flux received at earth during recovery from Forbush decreases. When approaching the earth from the sunward side the IMFI's scatter galactic cosmic rays diffusing towards the solar equatorial plane from higher heliolatitudes on to the interplanetary magnetic-field lines that connect to earth. When propagating past the orbit of the earth, the IMFI's set up a flow of scattered galactic cosmic-ray flux in the general direction of the earth. Most of these cosmic rays probably sink in the sun. Transient spatial anisotropies are thus set up in the vicinity of the earth in cosmic-ray intensity as viewed by ground-based detectors. Depending upon the relative position of the region abounding in IMFI's and the earth, these short-lived anisotropies appear either from sunward or antisun directions. Sometimes the configuration is such as to set up bidirectional anisotropies. Implications of this broad picture are discussed qualitatively. The analysis also enables one to place constraint on the mechanism responsible for heating the solar corona over active regions, which must be taken into account by all theoretical models on the subject. (auth)

Direct Energy Conversion

Refer also to abstract 48053.

47861 IMPROVEMENTS IN MAGNETOHYDRODYNAMIC GENERATORS. Croitoru, Zicu (to Electricite de France). British Patent 1,125,408. Aug. 28, 1968. Priority date Mar. 9, 1965, France.

The magnetohydrodynamic generator described is characterized by the fact that its electrodes in contact with the gaseous stream are made of semiconducting material and are unsegmented. The face of each of these electrodes that is not in contact with the gaseous stream is covered with a set of conducting electrode segments each in contact with a conductor. The segments of each set are arranged one after the other in the direction of flow of the gaseous stream. (M.H.R.)

47862 ON THE NONLINEAR BEHAVIOR OF A PULSED MHD CONVERTER. Treve, Yvain M. (American Science and Engineering, Cambridge, Mass.). SIAM (Soc. Ind. Appl. Math.) J. Appl. Math., 16: 344-62(Mar. 1968).

The equations which govern the behavior of a lumped-parameter model of a certain MHD generator previously considered were investigated. The performance of the device will be governed by the following dimensionless parameters: the ratio of initial magnetic and kinetic energies, the magnetic Reynolds number, and the ratio of the initial slug position to the channel length. The dimensionless equations which govern the performance are given, with initial conditions specified. The first differential equation is the definition of the dimensionless velocity; the second expresses the acceleration in terms of the difference between the magnetic energy densities on both sides of the slug. The third equation is obtained by equating the resistive voltage drop in the load loop to the rate of change of the flux linked by this loop. Behavior of the solution to these equations, especially of trajectories, is discussed for 4 cases. (BBB)

47863 THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE GAMMA-ELECTRIC CELL. Sampson, Henry Thomas. Urbana, Ill., Univ. of Illinois, 1967. 179p.

Thesis.

The gamma–electric cell (γ-EC) is a solid-state device for the direct conversion of gamma radiation into electrical energy. Electric currents are produced by using electrodes to collect Compton electrons arising from the interaction of gamma photons with a dielectric. Theoretical and experimental investigations of both short-circuit and high-voltage operation are reported. A series of γ-EC's having various compositions and geometries were irradiated in the U. of Illinois TRIGA Reactor and ^{60}Co facilities. Both single and multielectrode cells containing either lucite, silicone, polystyrene, or epoxy were tested. Stable voltage outputs exceeding 10 kV were attained for several cells. A cell containing parallel electrodes separated by 1-inch-thick sections of epoxy dielectric reached voltages between 15 and 19 kV during an 8-hour irradiation at a gamma dose rate of 10^6 R/hr. This cell also produced a stable output of 18 kV during a 5-hr reactor irradiation at 4×10^5 R/hr. Potentials in excess of 8 kV were attained with cells irradiated at 1.9×10^4 R/hr using a ^{60}Co source. Continuous outputs in excess of 2 kV were attained with several different cells during ^{60}Co irradiations involving periods up to two weeks. The theoretical work involved the development of equations which permit a current–voltage calculation for various incoming radiation-energy spectra, cell geometries, and materials. It is suggested that the gamma–electric cell shows promise as: (1) a self-powered radiation detector capable of measuring very high gamma flux intensities, and (2) a power supply for specialized high-voltage low-current applications such as electrostatic propulsion. (TSS)

47864 CONTRIBUTION TO THE THEORY OF A LOW-VOLTAGE ARC IN CESIUM. III. Moizhes, B. Ya.; Baksht, F. G. (Inst. of Semiconductors, Leningrad). Zh. Tekh. Fiz., 38: 709-23(Apr. 1968). (In Russian).

In the first parts of this article (Zh. Tekh. Fiz., 35: 1621(1965) and Fiz. Tverd. Tela, 2: 756(1960)) the authors calculated the volt–ampere characteristics of a thermionic converter using cesium vapor, under conditions when the electrons had a higher temperature near the anode than at the cathode. The present paper is devoted to the case when the cathode temperature is quite high and thermodynamic equilibrium prevails in practically the entire space between the anode and the cathode. In such a case the calculation of the electron temperature distribution, the electron density, and the potential in the gap reduces to a solution of a single second-order differential equation. This equation is solved for the case of scattering of electrons by neutral gas atoms and by ions. The volt–ampere characteristics are calculated and the parameters of the converter plasma are determined

for a high emission-current density and for a high cathode temperature, when the state of the bulk of the plasma is close to thermodynamic equilibrium from the very beginning. A maximum efficiency of 20% is expected from the calculations, although there are few experimental data to confirm the calculated results. (ATD)

47865 INVESTIGATION OF ELECTRONIC COOLING OF THE CATHODE OF A THERMIONIC CONVERTER. Kondrat'ev, F. V.; Sinyutin, G. V.; Tikhonov, V. F. Zh. Tekh. Fiz., 38: 704-8(Apr. 1968). (In Russian).

The purpose of the investigation was to determine the effect of the reduction of the cathode temperature of a cesium thermionic emitter with increasing current on the output properties of the emitter. The experiments were performed on a converter with planar electrode geometry with a cathode in the form of the end surface of a thin-wall molybdenum tube of 2.5 cm^2. The measurements were made at cathode temperatures 1400 to 1800C, a gap between the cathode and anode 0.1 to 2 mm, and a cesium vapor pressure 0.6 to 12 mm Hg. Unlike earlier investigations, the measurements were made not at constant cathode temperature, but at constant heat power delivered to the cathode. The cooling was determined by measuring the difference between the electric energy delivered to the cathode with the converter operating at no load and with the converter short-circuited. The electron cooling determined in this matter did not exceed 50 to 100C, amounting to a decrease of 10 to 15% in the output power. A simple approximation formula is obtained for the decrease in the cathode temperature due to electron cooling as a function of the converter current. The results show that at constant power input, the temperature drop first increases linearly with the current, but the increase slows down rapidly and saturation sets in at current densities above 8 or 9 A/cm^2. (ATD)

47866 NONEQUILIBRIUM MHD POWER GENERATION BY A SHOCK TUBE. Mori, Yasuo (Tokyo Inst. of Tech.); Imani, Kazutake. Nippon Kikai Gakkaishi, 70: 1762-71(Dec. 1967). (In Japanese).

Power generation experiments with a shock-wave tube were carried out to examine the phenomenon of nonequilibrium ionization and to find the possibility of MHD power generation using an inert gas. The results obtained are as follows: (1) The method of heating the shock tube to seed an inert gas with an alkali metal was tried. The conditions for MHD power generation were satisfied in the tube by this method for an alkali metal. (2) In the experiment with the tube, a nonequilibrium ionization was realized without unstable phenomena and the effect of boundary conditions. (3) The nonequilibrium ionization was affected by oxygen in the air, etc., and with over 100 ppm of impurities the electric conductivity decreased. (NSA of Japan)

47867 METHOD AND APPARATUS FOR HEATING A COMBUSTION SUPPORTING GAS FOR AN MHD DEVICE. (to Avco Corp.). British Patent 1,127,712. Sept. 18, 1968. Priority date May 2, 1966, United States.

An open-cycle MHD power generator is designed with means for preheating the gases and for recovering the alkali metal seed from the plasma. The means comprises alternately passing the exhausted seeded plasma through a storage-type regenerative heater until the temperature of all of the heat transfer medium is greater than that of the seed equilibrium vapor pressure, and passing the gas to be heated through the heat transfer medium. (D.L.C.)

47868 DIRECT GENERATION OF ELECTRICITY USING A MAGNETOHYDRODYNAMIC GENERATOR. (to Compagnie Electro-Mecanique). British Patent 1,127,734. Sept. 18, 1968. Priority date Oct. 16, 1964, France.

A process is given for MHD power generation without excessive temperatures such as that needed for the ionization of gases. In the process, a complex fluid is formed by suspending five bubbles of an insoluble gas in a conductive liquid (such as liquid metal) and used as the working medium in a thermodynamic cycle which includes an MHD generator. After passing through the MHD generator, the fluid is separated and then recombined in an emulsifier after heating, for recycle. Several apparatuses for carrying out the process are described. (D.L.C.)

47869 THERMOELECTRIC GENERATOR. (to United States Atomic Energy Commission). British Patent 1,128,605. Sept. 25, 1968. Priority date Jan. 28, 1965, United States.

A radioisotope thermoelectric generator is designed with high thermoelectric efficiency and source heat conservation for the production of milliwatt electric power. The generator comprises two cold posts, a hot post with a radioisotope source, and a continuous coil of low-thermal-conductivity series-connected thermocouples wound on the cold posts and tangential to the hot post. The thermocouples comprise duplex wire. Thermal insulation (silica powder) is provided, and the fuel capsule is suspended by means of high-strength low-thermal-conductivity steel wires. The materials for the components, e.g., thermocouples, insulation, etc., and methods for preparing them are discussed in detail. For one embodiment of the generator, 1.32 mW (5.5 V and 240 μA) is produced from 980 mW of heat. (D.L.C.)

47870 MHD POWER GENERATION USING AN RF-GENERATED NONEQUILIBRIUM PLASMA. Dworschak, J. R.; Brandmaier, H. E. (Curtiss-Wright Corp., Wood-Ridge, N. J.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2021-3(Oct. 1968).

A study was made of the use of a highly nonequilibrium plasma, generated by inductively coupled rf electric fields, in a MHD power generator operating at subatmospheric pressure and a high effective Hall parameter but with a moderate magnetic field. The generator, magnet, plasma generation section, and rf matching circuit are described. Operation was first in the Hall mode, and the load characteristic lines are straight. The theoretical relationship between effective Hall parameter, electron temperature, and reduced magnetic field indicates that a highly nonequilibrium, slightly ionized plasma and a large effective Hall parameter may be incompatible. Experiments in the Faraday mode were also conducted; load characteristics are also linear, but the open-circuit voltage is greater than predicted. The effects of decreasing the pressure to 0.35 and 0.15 torr on the open-circuit voltage–magnetic field characteristic are discussed. (D.L.C.)

47871 FUTURE ENERGY NEEDS VS THE ENVIRONMENT. Hornig, Donald F. EEI (Edison Elec. Inst.) Bull., 36: 206-10; 225(June-July 1968).

The current status and advantages of MHD generator systems for commercial power are considered against the background of future power needs. It is pointed out that nuclear power is not the only unconventional path available for more efficient and lower-cost central station power generation. The inherent attractiveness of an MHD generator is that it offers a major increase in thermal efficiency, from the present maximum of ~40% to the range of 55%. An MHD generator combines in a single unit the functions of the turbine and generator portions of a conventional turbo generator system. Since it has no moving parts exposed to high temperatures, it can use higher fluid temperatures than a conventional turbine, with an attendant gain in thermal efficiency. This increased efficiency, combined with the possibility of reduced capital costs, makes the MHD generator a promising prospect for achieving appreciable reductions in power generating costs. However, the high gas velocities and high temperatures present formidable problems for achieving a reliable generator because erosion of the walls will occur if there are any solids in the stream. The development of an MHD generator would assure that fossil fuels would continue to provide competition to nuclear power for many decades. Also, a closed-cycle MHD generator could be used in combination with a nuclear reactor. In addition to conservation of fuel supply, the increase in conversion efficiency with MHD would help to alleviate problems of air and water pollution by achieving a 15% reduction in the amount of effluent and waste heat. (BBB)

47872 IMPROVEMENTS IN OR RELATING TO MAGNETO-HYDRODYNAMIC ELECTRIC POWER GENERATING APPARATUS. Harrowell, Raymond Vivian (to Central Electricity Generating Board). British Patent 1,127,498. Sept. 18, 1968. Filed May 4, 1966.

An MHD power generating system fueled by hot conductive gases from fossil fuel is designed in which the surplus low-grade heat is utilized more fully. The system comprises an MHD duct, an auxiliary steam cycle, and an associated steam cycle having an independent source of high-grade heat but using the low-grade heat from the MHD system to heat the feedwater. Equations are derived which show the effects of the utilization of the low-grade heat on the efficiency of the associated steam cycle. (D.L.C.)

47873 THE ELECTRICAL CHARACTERISTICS AND THE BEHAVIOR OF MHD FLOW IN A HALL GENERATOR. Honma, Takuya; Kajikawa, Takenobu (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 483(Aug. 1968). (In Japanese).

The electrical characteristics of a linear-type Hall MHD power generator and a disk-type one are evaluated by means of quasi-one-dimensional analysis. The overall thermal efficiency is shown to be sensitive to the Hall parameter β_e. Comparison of the linear type with the disk one shows that the larger the flow velocity and the Hall parameter are, the more the nonuniformity is reduced across the stream of the linear channel. An estimation is made of changes caused in the properties of the MHD fluid and its electrical characteristics by the interaction between the Hall effect and the channel wall. The two-dimensional analysis is presented for

the steady, inviscid, and compressible MHD flow in a constant cross-sectional channel. The gas stream is divided into a number of layers, to which a perturbation method is applied as an approximating method. Numerical calculations are carried out for some typical conditions. (auth)

47874 CALCULATION OF THERMODYNAMIC AND ELECTRIC PROPERTIES OF COMBUSTION PRODUCTS FOR MHD GENERATORS. Kutsuwada, Takashi; Honda, Takeo (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 520-42(Aug. 1968). (In Japanese).

The thermodynamical and electrical properties of the combustion products, necessary for the analysis of MHD generator characteristics, are theoretically calculated. Fuels are light oil seeded with KOH dissolved in CH_3OH (KOH : CH_3OH = 1 : 5 on weight basis), heavy oil seeded with K_2SO_4, and methyl alcohol seeded with KOH. The calculation is carried out for various parameters, such as the seed/fuel, ratio, stoichiometry, N_2O_2, ratio, temperature (289 to 3600°K) and pressure (0.5 to 6.0 atm). The specific heat at a constant pressure, adiabatic constant, and specific heat ratio are calculated, taking the effects of the dissociation energy into account. In the Mollier diagram, curves for constant conductivity and for constant acoustic velocity are drawn for the convenience of the analysis of MHD generator. (NSA of Japan)

47875 MATERIALS OF SEMI-HOT WALL FOR MHD CHANNELS. Fushimi, Kozo; Okuo, Takayasu (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 445-52(Aug. 1968). (In Japanese).

For the purpose of improving the thermal efficiency of MHD power generators, some types of semi-hot insulating walls operating at around 1800°K were examined. For the selection of semi-hot wall materials, the following were tested: (1) castable alumina, (2) dense alumina tiles keyed on to a coolant system, (3) dense alumina tiles bedded in the troweled ceramics, and (4) ceramic and metal coating by the flame-spraying technique. It seems that the alumina castable bonded with $Al(H_2PO_4)_2$ and ceramic coating are suitable for the semi-hot insulating wall. (NSA of Japan)

47876 STUDY OF DESIGN OF MHD POWER GENERATING ACTION IN MHD PLANT. Onda, Kazuo; Takano, Kiyonami (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 427-44(Aug. 1968). (In Japanese).

In scaling up experimental MHD power generation equipment to a large MHD steam plant, problems of the MHD duct operation conditions, the combustor, and the nozzle were dealt with in the case of a residual oil–air burning, potassium-seeded plant. The heat losses in the combustor and the nozzle, and their dimensions as well, are calculated. The result shows that the radiant heat transfer is predominant in the case of an alumina semi-hot wall in comparison with the case of a gold-clad wall. Optimization of the MHD power generating duct without any loss is also carried out by means of the calculus of variation. The optimum size of the duct thus obtained is in good agreement with the one obtained by the ordinary method, the difference between the two being 10% at its maximum. The optimum velocity in the duct for the best MHD operating condition is found to be supersonic. (NSA of Japan)

47877 CONDUCTIVITY OF A GAS–SOLID MIXTURE. Honma, Takuya; Nomura, Osami (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 507-19(Aug. 1968). (In Japanese).

Various factors in the behavior of a gas–powder mixture are examined, and the possibility of giving a required conductivity to the working fluid in an MHD generator by means of the thermionic emission from a suspended powder of LaB_6 is discussed. The analytical calculation shows that the electron density of 10^{14} cm^{-3} is attained with a powder density of 10^{13} cm^{-3} for the case of the LaB_6 solid particles of 10^{-5} cm radius in such fundamental properties as transportation and relaxation phenomena, magnetohydrodynamic properties, and the mobility of solid particles in the fluid. The conductivity of a mixture of nitrogen gas and LaB_6 powder is calculated from the collision frequencies of an electron with the solid particles and neutral molecules. The effect of collision is analyzed and the results are divided into the following three types: (1) grazing collision due to the attractive force between electrons and charged solid particles, (2) distant encounters between them, and (3) collision between electrons and neutral molecules. The maximum conductivity is expected to be about 10 mho/m for a powder density of 10^{13} cm^{-3} ($r = 10^{-5}$ cm) at 2300°K with nitrogen gas. Other transport coefficients, such as the viscosity and the thermal conductivity, are also calculated; their values, however, are not appreciably affected by the powder suspension. The relaxation times between electron temperature and solid temperature of particles, and between gas temperature and solid temperature are also discussed by considering inelastic collisions. The magnetohydrodynamic equations of the powder suspension gas are deduced from the microscopic properties. The current equation (generalized Ohm's law) shows a considerably reduced effect of ion slip. (NSA of Japan)

47878 EXPERIMENTS ON THE MHD GENERATOR ETL MARK II. REPORT 1. Fushimi, Kozo; Ikeda, Shigeru (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 477-82 (Aug. 1968). (In Japanese).

The apparatus of combustion-driven Faraday-type MHD generator ETL Mark II and results of some experiments made on it are described. The apparatus was constructed to investigate experimentally the characteristics of the MHD generator, in which the MHD effect is dominant in comparison with the viscous one. The thermal input of this combustion chamber is about 30 MW. The fuel is diesel oil, the seeding material is potassium hydroxide solved in methyl alcohol, and the oxidizer is oxygen. The cross-sectional area of the generator channel is 9×11 cm^2 at the inlet and 9×25 cm^2 at the outlet. The length of the channel is 120 cm. The electrical output of 540 kW is generated at 2.26 kg/sec of the mass flow rate and 3.4 Wb/m^2 of the magnetic flux density, the gas velocity being supersonic all along the generator channel. (NSA of Japan)

Fluid Physics

Refer also to abstracts 47873, 47920, and 48126.

47879 IONIZED GAS FLOW PAST A CYLINDER AND A SPHERE. Pietrzyk, Z. A.; Rudowska, T. T. Arch. Mech. Stosow., 19: 231-41(1967).

Experiments were performed in an electromagnetic shock tube to study very high-speed, high-temperature flows about spheres and cylinders. The main flow field measurement was the luminous front of the disturbed flow around the body. The nominal Mach number of the flow was approximately 1.8 and the temperatures were generally in excess of 20,000°K. The Reynolds numbers of the flows estimated by the author were quite low although considerable uncertainty exists in the estimated values because of the high gas temperature and the high degree of ionization. Comparisons of the measured shock detachment distances were made with perfect gas calculations and were found to be in reasonable agreement. However, the considerable scatter in the experimental data make such comparisons qualitative in nature, at best. (App. Mech. Rev.)

47880 ON THE MOTION OF CONDUCTIVE, HOMOGENEOUS, AND ISOTROPIC ELASTIC BODIES IN THE PRESENCE OF A MAGNETIC FIELD. Agostinelli, Cataldo (Univ., Turin). Meccanica, 3: 57-68(June 1968).

The equations of motion are dealt with for a conductive, homogeneous and isotropic elastic body subjected not only to externally applied mass forces and surface forces, but also to a uniform magnetic field, in which an induced magnetic field is generated. On the assumption that the electrical conductivity is infinite, the problem of motion is reduced to the consideration of a single differential vector equation in which the displacement of a point in the elastic body is the only unknown. The conditions that must be satisfied at the surface are then considered. Using the generalized formula of Kirchhoff, formulas expressing the Cartesian components of the displacement, the cubic dilatation and the rotation components are established by means of the so-called fundamental elements. (auth)

47881 SOLUTION OF ONE INTEGRAL EQUATION OF MAGNETOHYDRODYNAMICS. Golovach, G. P. (Kiev State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. A, No. 7: 583-6 (July 1968). (In Ukrainian).

An integral equation of magnetic hydrodynamics is reduced to an equation well conditioned. Its solution is found in the form of a series of linear operators and the problem of its convergence is investigated. (auth)

47882 SIMILARITY SOLUTIONS OF BOUNDARY LAYER EQUATIONS IN THE PRESENCE OF MAGNETIC FIELD. Pop, I. (Univ., Cluj). Inzh.-Fiz. Zh., 15: 134-8(July 1968). (In Russian).

The viscous incompressible liquid flow past a body in the presence of a uniform magnetic field in the flow direction is studied. The class of potential motions is determined for which the system considered can be reduced to ordinary equations. (auth)

47883 INTENSIFICATION OF HEAT TRANSFER BY THE INFLUENCE OF A MAGNETIC FIELD UPON THE BOUNDARY LAYER. Brablc, Josef. Acta Tech. CSAV, 13: 199-235(1968).

The fundamental experimental proof of the intensification of the

heat transfer by a magnetic field is described, i.e., a phenomenon—as far as known—hitherto nowhere published in the literature, and contains also some theoretical explanations concerning the effect of the magnetic field on the boundary layer of a fluid. (auth)

47884 INSTABILITY OF A STRONGLY INHOMOGENEOUS PLASMA. Buchel'nikova, N. S.; Salimov, R. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Tekh. Fiz., 38: 611-17(Apr. 1968). (In Russian).

This is a continuation of an earlier study (Zh. Eksp. Teoret. Fiz., 35: 72(1965)) and is devoted to the development of instability in a plasma in which the Larmor radius of the ions is comparable with the dimension of the inhomogeneity. The investigated plasma was produced by surface ionization of potassium atoms on a tungsten plate heated to approximately 2000°K. The heating was by electron bombardment. It is shown that the instability observed in such a plasma, which is manifest in the excitation of azimuthal waves having components along the magnetic field direction, can be identified with ion–sound instability, and that the frequency of the oscillation does not depend on the magnetic field and is inversely proportional to the half-width of the plasma pinch. Measurements of the state of the plasma during the instability revealed that the plasma is strongly turbulent. (ATD)

47885 "IGNORING" WAVES. Infeld, E. (Univ. of Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 16: 539-41 (1968).

This note describes MHD waves that propagate in an incompressible, inviscid, perfectly conducting medium that is permeated by a uniform magnetic field, plus the field of a volume current undirectional with the field. The waves propagate in the direction of the uniform component of the field with the Alfvén velocity. They differ from the Alfvén waves one would obtain if the current was absent only in the values of the disturbed velocity and field (v and b), but not in the phase or group velocities. For this reason it is suggested that they be called "ignoring" waves. (auth)

47886 UNSTEADY FORCED-CONVECTION MHD HEAT TRANSFER IN A PARALLEL PLATE CHANNEL. Lindauer, George C.; Hsu, Chia-jung (Brookhaven National Lab., Upton, N. Y.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 1973-9 (Oct. 1968).

Unsteady-state, laminar, forced-convection heat transfer of an electrically conducting fluid subjected to a transverse magnetic field, flowing through a horizontal parallel-plate channel has been analytically investigated for the short-circuit condition using the method of characteristics. The transient is caused by step change in the axial pressure gradient of magnetic field. Both the entrance region and fully developed heat-transfer regions were considered for a fluid with constant wall temperature. The velocity profile was assumed uniform throughout the channel at any instant of time for the purpose of calculating convective heat transfer only, but the temperature profile distribution depends on both the axial and transverse linear coordinates. Numerical computations were carried out which indicate that the effect of the Reynolds number and Hartmann number on the fluid temperature during a transient varies greatly depending on their initial and steady-state values. In some cases, the peak transient temperature can be orders of magnitude greater than either the initial or steady-state value. (auth)

47887 MAGNETOHYDRODYNAMIC WAVES IN SECOND-ORDER FLUIDS. Chawla, Sahib Singh (Univ. of Leeds, Eng.). Int. J. Eng. Sci., 6: 75-87(May 1968).

A theoretical study was made of magnetohydrodynamic waves in certain incompressible second-order fluids, the constitutive equations connecting the stress and the rate of strain for such fluids having been introduced by Coleman and Noll. The basic equations of hydromagnetic interaction of second-order fluids are set up, from which the general linearized wave equation is obtained. It is shown that, in an unbounded fluid, there are 4 modes of wave propagation which are developed from 3 basic modes: electromagnetic waves, shear waves, and Alfvén waves. The nature of these modes was investigated for some special cases of interest. It was found that, apart from the finite conductivity, damping or attentuation of waves can be attributed largely to the acceleration vector μ_1, whereas μ_2 contributes to the modification of the phase velocity. Introduction of elastic effects in fluids greatly influences the efficiency of the generation of Alfvén waves at a solid boundary. (BBB)

Geophysics

Refer also to abstracts 47719, 47775, 48091, and 48408.

47888 (AD-664423) PROPAGATION CHARACTERISTICS OF PLANE SMALL AMPLITUDE HYDROMAGNETIC DISTURBANCES IN THE EARTH'S UPPER ATMOSPHERE. Report No. 135. Bostick, F. X. Jr.; Prince, C. E. Jr.; Smith, H. W. (Texas Univ., Austin. Electrical Engineering Research Lab.). July 15, 1964. Contract Nonr-375(14). 113p. CFSTI.

From the equations of motion, continuity, and state, written for a gas consisting of electrons and a single species of positive ions and neutral particles, together with Maxwell's equations, the general dispersion relation for plane small-amplitude hydromagnetic waves is derived. This relation, a polynomial of the fifth degree in the square of the propagation constant, is solved numerically for medium parameters representative of those encountered in the earth's upper atmosphere. Each of the five roots of the dispersion relation represents a different wave type. Two of the five wave types may be described as essentially transverse waves with the component field fluctuations occurring in planes perpendicular to the direction of propagation. Three of the wave types are longitudinal-type waves in which the field component fluctuations occur in planes parallel to the direction of propagation. Of the five wave types, only the two transverse waves appear to be responsible for the transmission of significant amounts of energy through the upper atmosphere. One of the wave forms, qualitatively described as a sound wave in the electron gas, is evanescent throughout the geomagnetic micropulsation frequency range and therefore should not exist with an appreciable amplitude anywhere in the upper atmosphere at those frequencies. (auth) (USGRDR)

47889 (AD-668332) EXCITATION OF HYDROMAGNETIC WAVES IN THE EARTH'S UPPER ATMOSPHERE BY SOURCES OF FINITE EXTENT. Report No. 146. Holden, H. D.; Bostick, F. X. (Texas Univ., Austin. Electrical Engineering Research Lab.). Apr. 1, 1968. Contract Nonr-375(14). 85p. CFSTI.

A boundary value problem based on a model of the earth's upper atmosphere is posed, formulated and solved. A point source is included within the stratified model thus necessitating a full three-dimensional treatment. (This is often an unnecessary complication if one can assume incident plane waves, current sheets, or other sources infinite in extent.) By formulating the problem in circular cylindrical coordinates, symmetries are maximized and double integral inversions are avoided. Due to the Earth's static magnetic field, the ionospheric media are anisotropic and the wave equation reduces to a dyadic Helmholtz equation. Seto (1964) has shown this equation to be separable in cylindrical coordinates under certain conditions. This important contribution by Seto is reviewed, somewhat extended, and adapted to the problem at hand. The separation equations lead directly to a dispersion relation. Electromagnetic field ratios (sometimes called wave impedances for an E/H ratio) are derived for an incremental cylinder wave. The boundary condition requirements are satisfied for the layered media numerically by using computational matrices. The advantages and limitations of this method are described. This is followed by a discussion of the contour used in the numerical evaluation of the integral. The vertical inhomogeneities in electrical parameters encountered in the ionosphere are quite severe. To accurately represent a continuously varying medium with a series of homogeneous layers each layer must be relatively thin in terms of wavelength. (USGRDR)

47890 (N-68-15138) COMETS IN THE SOLAR WIND. Brosowski, B.; Schmidt, H. U. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Translated from report MPI-PAE/Astro-1/67. 9p. (NASA-TT-F-11416). CFSTI.

Interaction of cometary and solar plasma components is sufficiently great to permit assumption of a common flow velocity and description of the process as a continuum. The density distribution of ions is regulated by their entrainment in the solar wind rather than by the spatial distribution of ionization probability. It is mainly the position of the shock front and the flow conditions in the low-density regions remote from the head of the comet which are influenced by the variable parameters, while the position of the interface and the density and velocity of the cometary gas in the vicinity of the head of the comet are only slightly affected. The influence of the charge exchange and ionization by electron impact are considered and the results discussed. (auth) (STAR)

47891 (N-68-23254) THE HIGH LATITUDE OUTER ZONE BOUNDARY FOR ≥40-keV ELECTRONS AS OBSERVED BY SATELLITE INJUN 3. Fritz, Theodore A. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Mar. 1968. Contract Nonr-1509(06). 35p. NASA-CR-94535). CFSTI.

The relationship of locally mirroring and precipitating ≥40-keV electrons was studied on magnetically quiet days. There was usually an enhancement of precipitating electrons at the high-latitude boundary for all local times. On the night side the flux of electrons always approached isotropy over the upper hemisphere

at the position of the satellite at this boundary. The condition of isotropy at the boundary was strongly dependent on local time; it was always present on the night side, but only infrequently with increasing local time toward local dusk (1800 hours), where isotropy was seldom observed. During magnetically quiet periods large intensities of ≥40 keV electrons were precipitating into the atmosphere for $\Lambda \geq 65°$. The position of the high-latitude boundary (intensity cutoff) varied by $\Delta\Lambda \approx 7°$ at low magnetic activity. On the night side, the latitude where the ratio of the trapped to the precipitated ≥40-keV particle fluxes breaks toward one (ϕ-boundary) is introduced as a more meaningful concept of the high-latitude limit to durably trapped ≥40-keV electrons than the usual intensity cutoff. The concept that the high-latitude outer zone boundary at all local times is controlled or driven by a mechanism acting primarily on the night side is introduced. (auth) (STAR)

47892 (N-68-23538) ANALYSIS OF POLAR CAP EVENTS. 4. ALMOST NECESSARY AND/OR SUFFICIENT CONDITION FOR SOLAR PROTON WARNING. Jonah, Fred C. (LTV Aerospace Corp., Dallas, Tex. [LTV Astronautics Div.]). Feb. 8, 1967. Contract NAS9-4911. 92p. (NASA-CR-62067). CFSTI.

A summary is presented on the data analysis used in the search for an observational technique that will distinguish flares that were followed by a polar cap absorption event from those that were not. The three solar or solar-induced conditions or phenomena that appear to be almost sufficient or necessary conditions for predicting that a flare will be followed by a PCA event are given, and possible modification, combinations, and problems associated with some of these conditions are discussed. An assessment is made of the major rf and solar events occurring during the period June 1957 to January 1963. (STAR)

47893 (N-68-23571) RADIOWAVE SCATTERING STRUCTURE IN THE DISTURBED AURORAL IONOSPHERE: SOME MEASURED PROPERTIES. VOLUME 1. Fremouw, Edward J. (Alaska Univ., College. Geophysical Inst.). June 1966. Contract NAS5-3940. 167p. (NASA-CR-94552; UAG-R-180(Vol.1)). CFSTI.

Multi-spaced interferometric measurements of a radio star are used to describe the radio wave scattering structure in a disturbed auroral ionosphere. Output voltage decreases are correlated to scattering by random noise theory and the statistical characteristics of amplitude, phase, and complex signal for a general arbitrary degree of scatter are developed. Application of this theory to observations with phase-switch and phase-sweep interferometers yields the received wavefront, the coherence radio, and the wavefront autocorrelation function which in turn are used to determine the optical depth and the ion-density irregularities in the ionospheric scattering region. Analyses of 49 visible fades reveal an approximately inverse-square dependence of the optical depth on radio frequency phase deviations. It is concluded that the disturbed auroral ionosphere displays evidence of quasi-periodic structure in the dimensional range of tens and hundreds of meters. Narrow beam photometer recordings of auroral luminosity during 100% visibility fades at night indicate that radio star visibility fades in the auroral zone result from scattering by irregularities directly associated with auroral forms. (STAR)

47894 (N-68-23790) ELECTRONIC DETECTOR FOR PERFORMING THE S-16 PARTICLE ASYMMETRY EXPERIMENT ON AAP MISSIONS. Final Report, July 1, 1967-April 30, 1968. (California Univ., Berkeley. Lawrence Radiation Lab.). Contract NAS9-5249. 70p. (NASA-CR-92120). CFSTI.

The S-16 particle asymmetry experiment, using nuclear emulsion detectors to obtain data on the processes through which protons are injected, trapped, and lost from the inner radiation belt and the changes that occur during the solar-cycle period, is described. Parameters measured by the experiment included pitch-angle distribution, directional flux, proton flux and energy spectrum, and particle mass measurements. The laboratory prototype telescope for electronic counting and particle identification is described; and theory of its operation, circuit design, pulse-height information analysis, and telescope performance is considered. Flight unit and telemetry requirements for a long-duration Apollo Applications Program mission are included; and an intercomparison is made of geomagnetic field models. (STAR)

47895 (N-68-24394) PECULIARITIES OF AURORAL RADAR REFLECTIONS AND THEIR CONNECTION WITH THE MAIN GEOMAGNETIC FIELD AND IONOSPHERIC CURRENTS. Bagaryatskii, B. A.; Fel'dshtein, Ya. I. Translated from pp 1-60 of Sect. 4 of the IGY Program, Aurora, No. 12, Academy of Sciences, USSR, Sov. Geophys. Comm., Moscow, 1965. 70p. (NASA-TT-F-11650). CFSTI.

Spatial and time characteristics of azimuthal distribution of aurora reflections in the frequency range of one meter were studied, based on radar reflection data from stations in the Northern Hemisphere. The azimuth preferences of these stations were compared with the direction of the magnetic field at the Earth's surface. Chapman's concept of a mirror-like, or orthogonal, reflection is taken as the starting point for a theoretical analysis. The structure of the real magnetic field of the Earth is calculated in order to interpret the results of the radar observations. Geomagnetic conditions for reflection and their connection with the structure of the constant magnetic field in the subarctic and arctic regions are analyzed. In the majority of cases, a symmetry was found to exist in the formation of preferred reflection zones relative to the direction of the real magnetic field. The most significant divergences from this rule involve stations located close to the center of the east Siberian anomaly of the vertical component (Tixie Bay, Yakutsk). (STAR)

47896 (N-68-24410) AURORAE AND AIRGLOW. Krasovskii, V. I. Translated from pp 1-76 of Sect. 4 of the IGY Program, No. 11, Academy of Sciences, USSR, Sov. Geophys. Comm., Moscow, 1965. 93p. (NASA-TT-F-11649). CFSTI.

Spatial and time variations of the integral continuum spectral distribution for the regions λ5700 and λ5300 Å were obtained from scanning photometer observations. The limits of the variations are from −24% to +9% of the mean value. The integral continuum atmospheric and extra-atmospheric components have different spectral distribution. (auth) (STAR)

47897 ELONGATION OF IRREGULARITIES IN IONOSPHERIC F REGION OVER THE MAGNETIC EQUATOR IN INDIA. Rastogi, R. G.; Deshpande, M. R.; Harishchandra (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys., 30: 1597-9(Aug. 1968).

The diffraction pattern of the field strengths of pulsed radio waves of frequency 4.7 Mc reflected from the F region near the magnetic equator in India was studied with the help of receiving aerials, six in the E-W and five in the N-S directions at distances of 60 to 480 m. The cross correlation between the signal strengths at paired aerials along the N-S direction decreased very slowly with increasing separation, while along the E-W direction the correlation decreases very rapidly with increasing distance between the aerials. This suggests that the irregularities causing the fading of short radio waves near the magnetic equator are highly elongated along the N-S direction. (auth) (UK)

47898 ANNUAL AND SEASONAL ANOMALIES IN THE ELECTRON CONTENT OF THE IONOSPHERE. Nelson, G. J. (Sydney Univ.). J. Atmos. Terrest. Phys., 30: 1591-6(Aug. 1968).

Relatively accurate diurnal variation curves of ionospheric electron content are presented for Sydney (33.8°S, 150.6°E), derived from recordings of the Faraday rotation of the 20 Mc transmissions from Sputnik 3 during the years of very high solar flux 1958-1960. These, and other Southern hemisphere results, are used in a comparison with Northern hemisphere results. It is found that the daytime electron content is a maximum in the equinox at high solar fluxes. In general the summer values are about the same in both hemispheres, whereas in winter the values in the Northern hemisphere are significantly greater than those in the Southern hemisphere. In both hemispheres the electron content is greater in winter than in summer at high solar fluxes and the reverse is true at low solar fluxes. These results imply both seasonal and annual anomalies in electron content at high solar fluxes. At low fluxes the seasonal anomaly is virtually absent, but the annual anomaly may still exist. There is also some evidence that the electron content at a given value of solar flux is greater on the declining than on the rising phase of the solar cycle. (auth) (UK)

47899 SCINTILLATION ON SAN MARCO 1 SATELLITE SIGNALS. Cappellini, V.; Checcacci, P. F.; de Giorgio, M. T. (Consiglio Nazionale delle Richerche, Florence). J. Atmos. Terrest. Phys., 30: 1581-4(Aug. 1968).

An analysis is described of the scintillation observed on the 20.005 MHz signals from the S. Marco 1 satellite. The observations were made by six stations situated at middle and low latitudes in both the northern and southern hemispheres. Results are presented of the scintillation occurrence and of the geographical distribution of the scintillation index. (auth) (UK)

47900 LOW-FREQUENCY PLASMA INSTABILITIES IN THE IONOSPHERE. Whitehead, J. D. (Univ. of Queensland, Brisbane). J. Atmos. Terrest. Phys., 30: 1563-79(Aug. 1968).

The possibility of plasma instabilities in the ionosphere was investigated. Low-frequency instabilities due to a background vertical gradient of ionization were considered, and formal solutions for plane wave irregularities of arbitrary direction are given. The growth of irregularities due to electron and ion drift was investigated and is shown to be a maximum for irregularities which are not quite aligned along the magnetic field. The

diffusion and velocity of small scale irregularities are not very dependent on the background gradients, allowing simplification of the analysis. It is shown that diffusion cannot be described in terms of a tensor, and that while the velocity of field-aligned irregularities is almost equal to the electron drift velocity, that of irregularities far from field aligned is almost equal to the ion drift velocity. Boundary conditions between layers are discussed. For a region consisting of two exponential layers with a maximum electron density at the boundary, it is shown that thin horizontal irregularities (which could be interpreted as being sporadic-E) cannot be the result of this instability. It is also shown that if the layer of interest (with an exponentially increasing background ionization density) is bounded by a conducting ionosphere the diffusion rate is increased and would usually prevent growth of the instability. (auth)(UK)

47901 SEASONAL VARIATION OF THE LOWER IONOSPHERE AT WALLOPS ISLAND DURING THE IQSY. Mechtly, E. A. (Univ. of Illinois, Urbana); Smith, L. G. J. Atmos. Terrest. Phys., 30: 1555-61(Aug. 1968).

Electron density profiles for the lower ionosphere between 55 and 105 km are presented for each of five Nike–Apache rockets launched from Wallops Island, Virginia near times of solstice or equinox of the International Quiet Sun Years of 1964 and 1965, at the same solar zenith angle of 60°. Summer solstice and equinox electron densities were larger than those of winter solstice by a factor of about four between 65 and 80 km. Above and below this region systematic seasonal differences were not apparent. The profiles are compared with the profiles of Aikin, Belrose, Deeks, and Hall. (auth)(UK)

47902 PERSISTING 24-SEC PERIODICITY IN AURORAL X RAYS INTERRUPTED BY SUDDEN GEOMAGNETIC IMPULSES. Bewersdorff, A. (Laboratoire de Physique Cosmique, Meudon, France); Kremser, G.; Riedler, W. J. Atmos. Terrest. Phys., 30: 1547-53(Aug. 1968).

Observations are described of an auroral x-ray event, which showed very persistent and regular intensity variations. The sequence of regular variations was interrupted by two sudden geomagnetic impulses, but probably reappeared later on. This puts some restraints on the nature of possible modulation mechanisms. (auth)(UK)

47903 GYRO-WAVE INTERACTION IN THE IONOSPHERIC D LAYER. Setty, C. S. G. K. (Univ. of Delhi). J. Atmos. Terrest. Phys., 30: 1535-45(Aug. 1968).

Pulsed-wave interaction experiments, similar to those first described by Fejer (1955), were made at Armidale (lat. 30°32′S; long. 151°38′E) using gyrowaves during daytime. It is shown from the experimental results that the interaction, using a Disturbing wave of 1.78 Mc, and extraordinary mode and a Wanted-wave of 2.12 Mc and ordinary mode, takes place in a layer of about 3-km thickness at 67 ± 2 km height. Using Bailey's theory of wave interaction and the standard magneto-ionic theory it is found that the electron concentration at the level of interaction is nearly 1000 per cm^3 and the collision frequency is $(1.3 \pm 0.2) \times 10^7$ per sec. The constant G which occurs in the wave interaction theory is found to be $(1.3 \pm 0.2) \times 10^{-3}$. (auth)(UK)

47904 NONLOCAL ENERGY DEPOSITION IN THE IONOSPHERE AND THE PHOTOELECTRON ESCAPE FLUX. Whitten, R. C. (Ames Research Center, Moffett Field, Calif.). J. Atmos. Terrest. Phys., 30: 1523-33(Aug. 1968).

The theory of nonlocal energy deposition in the ionosphere developed by Geisler and Bowhill (1965) is generalized to include the absence of thermal equilibrium among the neutral, ion, and electron gases. Analytic expressions for certain ratios of the electron-to-neutral scale heights are presented. These include both the nonlocal energy deposition factors and the escape flux density of photoelectrons. (auth)(UK)

47905 PHOTOMETRIC OBSERVATIONS IN SOUTH AMERICA AND THEIR RELATION TO TRAPPED RADIATION. Eather, R. H.; O'Brien, B. J. (Rice Univ., Houston, Tex.). J. Atmos. Terrest. Phys., 30: 1585-90(Aug. 1968).

Highly sensitive tilting-filter photometers were used to measure night airglow near Rio de Janeiro on Oct. 3 and 4, 1967. The study was motivated by a search for atmospheric optical emissions resulting from the enhanced loss of trapped ions into the atmosphere where the magnetic field is weak. While normal night airglow emissions of O I were found at 5577Å (from 75 to 160 Rayleighs) and 6300Å (from 25 to 250 R), no anomalous particle excited emissions were detected. Upper limits of 4278Å[N_2^+], 4861Å[Hβ], and 5876Å[HeI] intensities were respectively 0.2 R, 0.7 R, and 1 R. It was concluded that in late 1967 the inner zone fluxes of trapped ions of a few keV were at least one thousand times less than those reported from satellite measurements of the early 1960's. Furthermore, the upper limit to the energy flux of charged particles bombarding the atmosphere was set by these measurements as less than (0.7×10^{-3}) ergs cm^{-2} sec^{-1}. (auth)(UK)

47906 ACOUSTIC WAVES IN THE LOWER IONOSPHERE. Kantor, Gideon; Pierce, Allan D. (Avco Space Systems Div., Lowell, Mass.). J. Atmos. Terrest. Phys., 30: 1497-1503 (Aug. 1968).

A discussion is given of the electron and ion motions induced by an acoustic wave in the ionosphere. A simple model for the interaction is derived from the fluid equations governing a three-component partially ionized gas and by consideration of the magnitudes of the relevant parameters pertinent to the lower ionosphere. The resulting model, appropriate for frequencies between 0.01 and 10 Hz and for altitudes up to 120 km, takes into account the possibility of an induced electric field being created by electron–ion motion. It is shown that electron and ion velocity components along the propagation direction tend to be nearly equal and that, in addition, the ion velocity is always nearly parallel to the neutral velocity. A simple model, valid for angles of propagation up to 70° from magnetic field lines, resulting from the analysis, indicates that electron velocity is along magnetic field lines, but is of such magnitude that its projection along the propagation direction is equal to the neutral velocity. Although the induced electron velocity may be greater than the neutral velocity, the relative fluctuations in electron density tend to equal those of the neutrals. At ionospheric heights near 90 km, they may be comparable to those of the neutrals even at propagation directions perpendicular to magnetic field lines. (auth)(UK)

47907 NEW METHOD OF ANALYSIS OF IONOSPHERIC DRIFT MEASUREMENTS. Jones, D.; Maude, A. D. (University Coll. of Wales, Aberystwyth). J. Atmos. Terrest. Phys., 30: 1487-95(Aug. 1968).

A method of analysis of the results of a Mitra-type measurement of ionospheric drift is described which is particularly suitable for an examination of the hypothesis that in the apparent motion different scale sizes move at different velocities instead of the motion being simply due to horizontal movement of the neutral air. (auth)(UK)

47908 SOME FURTHER CORRELATIONS IN MAGNETIC VARIATION. Osborne, Denis G. (University Coll., Dar es Salaam, Tanzania). J. Atmos. Terrest. Phys., 30: 1479-86 (Aug. 1968).

The daily variation of the horizontal component of the Earth's magnetic field shows considerable variability from day to day. Correlation coefficients were found between variation at observatories at different latitudes for groups of quiet days for three seasons. These coefficients suggest that there are some similar causes for the variability of the magnetic field at different locations. An earlier paper (1964, 1966) gave an analysis of this type for data from observatories in North America and the magnetic equatorial region in Peru. Information from South American stations in the middle latitudes is now included. This makes it possible to examine the relationship between ionospheric currents over the Northern and Southern Hemispheres, and to compare the equatorial electrojet with the general ionospheric current system. The northern and southern foci of the current loops are found to move independently. The variability in position of the electrojet over Peru appears independent of the variability in other parts of the current system. The comparison between the variability in electrojet strength with the rest of the current system suggests that the amplification to which the jet is attributed must, itself, vary considerably from day-to-day. (auth)(UK)

47909 ON THE BEHAVIOR OF f_0F2 DURING THE MAY 20, 1966 SOLAR ECLIPSE. Anastassiades, Michael; Moraitis, George (National Observatory, Athens). J. Atmos. Terrest. Phys., 30: 1471-8(Aug. 1968).

Ionospheric observations along the central line of the May 20, 1966 annular solar eclipse showed that, during the first half, f_0F2 increased. This behavior can be explained by assuming a rapid downward diffusion of ionization from ionospheric heights greater than $h_{max}F2$, the difference being related to the difference between exospheric electron temperature T_e and the neutral temperature T_n, the former being the larger. The results of May 20, 1966 eclipse over Northern Africa and Southern Europe indicate that latitude and magnetic dip have a definite influence only on the progressing significance of the f_0F2 increase. Observations from the present and previous eclipses show that an increase in f_0F2 can be expected with eclipses that occur during years of sunspot minimum for low latitudes and for magnetic dip much less than 60°. (auth)(UK)

47910 AURORAL MOTIONS OBSERVED WITH RIOMETERS: LATITUDINAL MOVEMENTS AND A MEDIAN GLOBAL PATTERN. Hargreaves, J. K. (Environmental Science Services Administration, Boulder, Colo.). J. Atmos. Terrest. Phys., 30: 1461-70(Aug. 1968).

Riometers at L values of 4, 7, and 14 were used to elucidate the latitudinal movement of auroral absorption events, and the pattern so derived is combined with the results of a previous study on longitudinal movements. The resulting picture shows that in a median case the auroral disturbance begins near L = 7 at the midnight meridian, and spreads out with velocities of about 0.4 R_e/min in the equatorial plane. It appears possible that the factor governing the time sequence of auroral precipitation is a hydromagnetic disturbance. (auth)(UK)

47911 LOW-FIELD CONDUCTION IN THE D REGION OF THE IONOSPHERE IN THE PRESENCE OF A HIGH-FIELD SIGNAL. Nag, B. R.; Purkait, N. N. (Univ. of Calcutta). J. Atmos. Terrest. Phys., 30: 1455-60(Aug. 1968).

The theory of conduction in the lower ionosphere, due to a low-field probing signal, in the presence of a high-field disturbing signal, was developed, neglecting the effect of the Earth's magnetic field and considering elastic collisions with neutral molecules. It is found that the value of the conductivity obtained from the assumption of the Maxwellian velocity distribution of the electrons is considerably higher than that obtained for the actually existing non-Maxwellian distribution. It is also observed that the ratio of these two values decreases with increase in the amplitude of the high-field signal. The importance of this result in relation to the interpretation of cross-modulation results is discussed. (auth)(UK)

47912 DINAMIKA RADIATSIONNYKH POYASOV ZEMLI. (Dynamics of Radiation Belts of the Earth). Tverskoi, B. A. Sovremennye Problemy Fiziki. Moscow, Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury, 1968. 224p.

Physical conditions of the magnetosphere (magnetic field, plasma, and various-frequency electromagnetic pulsations) are reviewed in the first chapter. The second chapter covers data on the structure and dynamics of the radiation belts. The transport of particles captured by geomagnetic perturbations, the electric fields induced by these perturbations, particle drift, and coefficient of diffusion are discussed in the third chapter. The fourth chapter analyzes the role of transport in radiation belt formation, including the appearance of protons with energies <30 MeV in the magnetosphere and fast electron diffusion. General problems of stability in the radiation belts, including electron leakage into the ionosphere, are discussed in the fifth chapter. The damping constant of waves with $\omega \gtrsim \Omega_H$ in the magnetosphere is calculated in an appendix. 156 references. (R.V.J.)

47913 PIONEER 6 OBSERVATIONS OF A STEADY-STATE MAGNETOSHEATH. Wolfe, J. H.; McKibbin, D. D. (Ames Research Center, Moffett Field, Calif.). Planet. Space Sci., 16: 953-69(Aug. 1968).

Results are presented concerning the observations made by Pioneer 6 during the unusually quiet transit of the magnetosheath. Pioneer 6, launched on December 16, 1965, traversed the magnetosheath near local sunset a few degrees below the ecliptic plane. At this time interplanetary conditions, as determined by subsequent flight data, were extremely quiet and $A_p \sim 0$. The data revealed a density spike associated with the shock front and an increase in density by a factor of approximately 3 as the flow crossed the shock. The density increase in the spike itself was more than an order of magnitude above the free-stream value. The solar wind electrons appeared to increase in temperature by approximately a factor of 4 at the shock front, and subsequently cooled by about a factor of 2 as the flow proceeded downstream. The solar wind ions, on the other hand, although heated to about the same extent as the electrons in the vicinity of the shock front, did not appear to cool appreciably in the magnetosheath and, in addition, they revealed nonthermal characteristics. The data also indicate that 100-eV electrons may be injected into the magnetosphere at the Earth's magnetic field boundary and undergo further heating in the outer part of the magnetosphere. (auth) (UK)

47914 COMPARISON OF THEORETICAL PREDICTIONS OF THE FLOW AND MAGNETIC FIELDS EXTERIOR TO THE MAGNETOSPHERE WITH THE OBSERVATIONS OF PIONEER 6. Spreiter, John R.; Alksne, Alberta Y. (Ames Research Center, Moffett Field, Calif.). Planet. Space Sci., 16: 971-9(Aug. 1968).

Data from Pioneer 6, obtained along the portion of its trajectory from the magnetosphere boundary to beyond the Earth's bow wave, are compared with theoretical results calculated using the continuum fluid model of the steady-state interaction of the solar wind and the geomagnetic field together with the observational values for the velocity, density, temperature, and the magnetic field in the incident solar wind. It is found that the agreement between the calculated and observed values is, in general, very satisfactory. This conclusion applies to the entire run of values for the velocity, density, and magnetic field intensity as well as to the locations of the virtually discontinuous changes in values at the magnetosphere boundary and the bow wave. (auth) (UK)

47915 UPPER ATMOSPHERE DURING GEOMAGNETIC DISTURBANCES. I. SOME REGULAR FEATURES OF LOW-LATITUDE AURORAL EMISSIONS. Truttse, Yu. L. (Inst. of Physics of the Atmosphere, Moscow). Planet. Space Sci., 16: 981-92 (Aug. 1968).

A search is made for correlation between the intensities of emissions of low-latitude auroras and different geomagnetic indices. It is found that $\lg I(6300) = \beta D_{st} + G$ where I(6300) is the intensity of the oxygen emission at 6300 Å, and β and G are empiric coefficients: the value β is a function of the geomagnetic latitude and varies within the limits of $2 \times 10^{-3} - 1.7 \times 10^{-2}$ for latitudes of 35 to 60°, while the value G represents the variations I(6300) as a function of solar activity, and from 1957 to 1959 varied within the limits of 1.9 to 0.9. The energy released in λ6300 during low-latitude auroras on the night side within the limits from −60 to +60° of the geomagnetic latitude may hence be calculated. During the aurora on February 11, 1958 it was 5×10^{23} ergs. The global value must be much greater since the λ6300 emission on the day-side and in high-latitude regions was not taken into account in the calculation. It exceeds the energy which is usually ascribed to geomagnetic storms. On February 11, 1958 D_{st} reached −409 gammas. Such D_{st} can be obtained as a result of uniform inflation of the magnetosphere by charged particles with the total energy of 1.7×10^{23} ergs. (auth) (UK)

47916 LENS EFFECT OF THE EARTH'S IONOSPHERE ON RADIO WAVES REACHING THE MOON. Gold, T.; Silvestro, G. (Cornell Univ., Ithaca, N. Y.). Planet. Space Sci., 16: 999-1009(Aug. 1968).

Radio waves from a distant source at grazing incidence on the Earth's atmosphere are focused at the Moon. The intensity distribution at the Moon's distance is calculated. The outer ionosphere focuses most strongly radio waves of a wavelength $\lambda \gtrsim$ 1 m, giving a maximum increase in intensity of about 20. The E and F layers give a smaller focusing effect. (auth) (UK)

47917 CHARGE EXCHANGE AND ION DIFFUSION FOR THERMAL NONEQUILIBRIUM CONDITIONS. Banks, Peter M.; Holzer, Thomas E. (Univ. of California, San Diego, La Jolla). Planet. Space Sci., 16: 1019-22(Aug. 1968).

The ion−neutral diffusion coefficient for resonance charge exchange was obtained directly from Boltzmann's equation for conditions of separate ion and neutral Maxwellian gas temperatures. With application to the problems of $O^+ - O$ and $H^+ - H$ diffusion it is found that there is little effect upon the F_2-region maximum, since $T_i \simeq T_n$. At higher altitudes, where $T_i > T_n$ to a significant degree, the diffusion coefficient becomes substantially larger than previous expressions based upon a condition of thermal equilibrium between ion and neutral gases. (auth) (UK)

47918 DYNAMICS OF THE CHAPMAN–FERRARO MODEL OF THE MAGNETOSPHERE. Buffalano, Charles (Yale Univ., New Haven). Planet. Space Sci., 16: 1023-34(Aug. 1968).

A detailed analysis of the homogeneous dynamics of the Chapman−Ferraro model of the surface of the magnetosphere failed to uncover a mechanism capable of amplifying initially small disturbances to the point where nonlinear effects become important. Disturbances are shown to convect rapidly over the surface of the magnetosphere, blown along by the tangential component of the solar wind. As they convect, the magnetic field acts to disperse them and reduce their gradients. The effect of surface curvature is to reduce further the disturbance everywhere except in the polar dimples, where some amplification results. The disturbances are blown out of the dimples so rapidly, however, that amplification does not exceed 1.25. (auth) (UK)

47919 A NOTE ON THE SEASONAL VARIATION OF THE IONOSPHERIC ELECTRON CONTENT AND SLAB THICKNESS OVER WASHINGTON, D. C. Goodman, John M. (Naval Research Lab., Washington, D. C.). Planet. Space Sci., 16: 1073-8(Aug. 1968).

The seasonal and solar activity dependence of the subsatellite electron content, $\int Ndh$, and the effective slab thickness, τ, over Randle Cliff, near Washington, D. C., during the ascending phase of solar cycle No. 20 are discussed. Results of a Faraday fade rate analysis indicated that during 1966−67, the electron content and slab thickness, exclusive of summertime, were approximately

given by the empirical relations $\int Ndh = 7.70 \times 10^{17} \cos^{3}\psi$(el/m^2) and $\tau = 550 \cos\psi$(km), where ψ is the local noontime solar zenith angle. By comparison with Echo II radar results, the slab thickness was found to be an increasing function of $\cos\psi$ regardless of solar activity, but $\int Ndh$ was more or less independent of solar zenith angle during sunspot minimum. (UK)

47920 MAGNETOHYDRODYNAMICS IN THE MAGNETOSPHERE. Dungey, J. W. (Imperial Coll. of Science and Tech., London). Ann. Geophys., 24: 673-80(Apr.-June 1968).

The validity of hydromagnetics for application to plasmas in which the mean free path is long, as in the magnetosphere, is discussed. It is pointed out that the anisotropy of the pressure is essential in the equilibrium magnetosphere, because it is needed to describe the trapping mechanism of the radiation belts, and the ring current is directly related to these. It is shown that for interchange flow in the magnetosphere, ionospheric drag is more important than inertia. The flow associated with substorms is discussed and related to reconnection. This flow also offers an explanation for the existence of a plasmapause. The normal modes of hydromagnetic oscillation of the magnetopause are discussed, particularly quasitransverse oscillations whose phase varies rapidly with longitude. The Kelvin–Helmholtz instability of the magnetopause is a possible generating mechanism. The interaction of such modes with energetic particles is considered, and the particles may cause strong damping or another generating instability. (auth)

47921 SOME QUANTITATIVE ASPECTS OF ELECTRON PRECIPITATION IN AND NEAR THE AURORAL ZONE. Bailey, D. K. (Environmental Science Services Administration Research Labs., Boulder, Colo.). Rev. Geophys., 6: 289-346(Aug. 1968).

Observations made with the International Quiet Sun Years (IQSY) forward-scatter paths, supplemented with a special program of ground-based observations at the midpoint of one of the two forward-scatter paths in Alaska, have been used as a basic body of experience against which to discuss some of the quantitative aspects of electron precipitation into the ionosphere and mesosphere. Because most of the electron precipitation events from which one can extract quantitative spectral information occur in or near the auroral zone, the results obtained in Alaska are the main subject of this study and review. (auth)

47922 SUDDEN COMMENCEMENT AMPLITUDES AND STORM RANGES IN THE INDIAN EQUATORIAL BELT. Bhargava, B. N. (Colaba Observatory, Bombay). Indian J. Meteorol. Geophys., 18: 267-72(Apr. 1967).

For the highly active period of solar cycle 19, amplitudes of storm commencements (SSC) at the 3 stations in the Indian equatorial region are examined. Storms with a large main phase are found to accompany sudden commencements occurring during the daytime. The equatorial enhancement in SSC amplitudes in the horizontal force is found to be almost uniform from 2.7° magnetic latitude to the dip equator except for a few hours centered on local noon. In the vertical force, the enhancement at Trivandrum near the dip equator is found to be extremely large. The occurrence of storms with large ranges in the vertical force and the seasonal characteristics of the ranges are also investigated. An unexpected quasi-periodic variation in ranges in the vertical force was found at Kodaikanal. Probable causes of large amplitudes of SSCs and storm ranges in the vertical force are discussed. (Meteorol. Geoastrophys. Abstr.)

47923 BEHAVIOR OF OXYGEN 6300 A EMISSION IN THE NIGHT AIRGLOW AND THE DYNAMICS OF IONOSPHERE IN LOW LATITUDES. Pal, S. R.; Kulkarni, P. V. (Physical Research Lab., Ahmedabad, India). Ann. Geophys., 24: 399-405 (Apr.-June 1968).

In the nocturnal variation of the 6300 Å airglow emissions, during the second half of the night, there is often observed an intensity peak which is quite distinct from the slowly rising post-midnight enhancement followed by the rapidly rising predawn enhancement. This "post-midnight 6300 Å hump" as a matter of fact is superimposed on the post-midnight enhancement. The photometric observations of 6300 Å at Mt. Abu (India) and Haleakala (Hawaii) show good covariance with the F-region ionospheric parameters. The post-midnight enhancement and the superposed 6300 Å hump can be reasonably accounted for by considering the dynamics of the nighttime F region including vertical drifts during those hours. (auth)

47924 STUDY OF LOW-ENERGY PROTON SPECTRA. Kuck, George A. (Air Force Cambridge Research Lab., Bedford, Mass.); Theodoridis, George C. Ann. Geophys., 24: 407-10 (Apr.-June 1968).

The proton energy spectra from L = 2 to L = 3 were measured by a two-detector solid-state telescope carried by a rocket launched on March 30, 1965. The spectra were found to be well fitted by single exponentials of the form exp $(E-/E_0)$ for the two energy regions $0.2 \leq E \leq 1.5$ MeV and $1.5 \leq E \leq 4.0$ MeV. The energy parameter was found to be $0.4 \leq E_0 \leq 1.2$. The spectra were L-dependent and in qualitative agreement with the inward radial diffusion theory. (auth)

47925 EFFECT OF IONOSPHERIC MODULATION ON THE CORRELATION OBSERVED BETWEEN THE MAGNETIC PULSATIONS OF MIDDLE LATITUDE. Schlich, R. (Institut de Physique du Globe, Paris). Ann. Geophys., 24: 411-29(Apr.-June 1968). (In French).

There is a striking morphological similitude between magnetic pulsations Pc3, Pc4, and Pi2 observed at the conjugate stations Hurouqué and Hermanus. These pulsations appear simultaneously with usually identical periods. Polarization studies have shown that these perturbations are propagated preferentially from one hemisphere to the other in a given mode which is the lefthand polarized mode or anisotropic mode. The signal amplitudes are generally different at conjugated stations. The mean intensity of these pulsations is compared and it is shown that the intensity variations, as observed between conjugated stations, are strongly correlated for the night pulsations and weakly correlated for the pulsations excited in the day part of the magnetosphere. These results are interpreted as an effect of ionospheric absorption, at night the attenuation is negligible but at day time the attenuation can take different values at both ends of the same line of force affecting the observed amplitude ratio. (auth)

47926 THEORY OF GUIDING BY SIMPLE DUCTS OF PLASMA IN THE FREQUENCY RANGE OF WHISTLERS. Cairo, Laurent (Centre National de la Recherche Scientifique, Saint-Maur, France). Ann. Geophys., 24: 431-49(Apr.-June 1968). (In French).

The theory of propagation inside homogeneous plasma waveguides is extended to the ducts resulting from an enhancement or a reduction of ionization aligned with the magnetic field. The plasma is cold and collisionless. The study is made in the whistler frequency range, where the conditions for perfect guidance and for the existence of "volume waves" inside the duct lead one to consider only the ducts of reduced density. Ducts with two kinds of boundaries are studied, namely plane and cylindrical; the corresponding fields are described by means of a common notation. The dispersion equation of the waves is solved numerically. The influence of the physical parameters (discontinuity in electron density and guide width) on the dispersion of the waves is discussed. (auth)

47927 OBSERVATION OF ELECTRON CONTENTS WITH THE RADIO-SURVEY SATELLITE EXPLORER 22 (BE-B). Burkard, O. M. (Univ., Graz). Ann. Geophys., 24: 451-7(Apr.-June 1968). (In German).

A detailed illustration is given of the evaluation method applied at Graz to enable its use also in other stations. This method combines a relatively small amount of computing with an optical adjustment, thus granting a quick and reliable determination of the electron content. In case of doubt, and as a check, a diagram which can be set up for every observation station is used in addition. The values of electron content obtained at Graz (covering the period from October 1964 to July 1967) are presented in a diagram revealing without difficulty the seasonal variations and the increase of the electron content with the increasing activity of the Sun. Finally, it is shown for the winter 1966 (as for 1964 and 1965) that the marked diurnal variation ($J \propto \cos\chi^{3}$) can be established, whereas there is no clear connection during the summer months. (auth)

47928 MAGNETIC AND AURORAL CONJUGACY. Bond, F. R. (Dept. of External Affairs, Melbourne). Ann. Geophys., 24: 459-65(Apr.-June 1968).

The relation between quiet auroral arcs and invariant colatitude $\theta_2 \sim \theta_4 = 30°$ is discussed, and it is postulated that, if the aurora could exist in the absence of the solar wind, then the limit $\theta_4 \to 0$ defines the auroral poles. Three latitude–longitude systems are derived in relation to the auroral poles. Examples of instantaneous conjugacy of auroral forms are given and three seemingly tenable hypotheses concerning conjugate behavior are enunciated. It is concluded that the search for accuracy in determining magnetic conjugacy is likely to confirm the concept of instantaneously conjugate auroral displays in the auroral and cis-auroral regions. Further study in the trans-auroral region is desirable. (auth)

47929 CONJUGATE POINTS PHENOMENA ASSOCIATED WITH ENERGETIC PARTICLES, MAGNETIC OBSERVATIONS. Jacobs, J. A.; Watanabe, T. (Univ. of British Columbia, Vancouver). Ann. Geophys., 24: 467-75(Apr.-June 1968).

A review is given of conjugate point phenomena associated

with variations of the Earth's magnetic field. Bays and magnetic storms are first considered and it is shown that for auroral-zone stations it is more meaningful to speak of conjugate areas elongated along iso-L lines. In contrast, variations at low latitudes are essentially worldwide in character and correlate with movement of the boundary of the magnetosphere in response to changes in the solar wind. Micropulsations are discussed in some detail—particularly those of shortest period (hm emissions). In mid and low latitudes, micropulsations are a large area type of perturbation—in particular the conjugate area for Pc1 (pearls) seems to be quite extensive. Pulse-to-pulse correspondence on a magnetogram is often absent although there are a number of remarkable cases which indicate that pearls occur alternately at the northern and southern auroral zone stations—this is consistent with the theory that hm emissions are caused by a hm wave packet propagating in the magnetosphere under the guidance of the Earth's magnetic field and bouncing between the two hemispheres. However a phase shift noticeably different from 180° has been reported from the near conjugate pair of stations, Borok and Kerguelen Island. Other short-period micropulsations—continuous sub-elf emissions, noise bursts, SIP's and IPDP's—are considered. In contrast to Pc1's, the onset of a SIP (a typical Pi1 type of micropulsation) and an IPDP appears to be simultaneous at two conjugate stations. Finally, the conjugacy of longer-period micropulsations is discussed. (auth)

47930 AURORAL TYPE ABSORPTION IN THE HIGH LATITUDE MAGNETIC CONJUGATED REGIONS. Driatskii, V. M. (Arctic and Antarctic Research Inst., Leningrad). Ann. Geophys., 24: 477-80(Apr.-June 1968).

The behavior of auroral type absorption events in two magnetic conjugated points: Mirny Observatory (Antarctica) and Heis Island (the Arctic) is discussed. Cosmic radio noise records obtained at these stations were analyzed. The intensity of the conjugate events has been revealed to be larger in the local winter, auroral absorption at Mirny commencing earlier than at Heis Island. Some suggestions on the nature of the obtained regularities are offered. (auth)

47931 THEORETICAL CALCULATIONS OF THE CONJUGATE PREDAWN EFFECTS. Fontheim, Ernest G.; Beutler, Abigail E.; Nagy, Andrew F. (Univ. of Michigan, Ann Arbor). Ann. Geophys., 24: 489-95(Apr.-June 1968).

The flux spectrum of escaping photoelectrons was calculated for the four zenith angles of 100°, 95°, 90°, and 85° in midsummer at the conjugate point of Puerto Rico during solar minimum. Traveling along the magnetic field lines this flux heats the protonosphere and the predawn ionosphere over Puerto Rico. As a result of the heat input into the protonosphere, heat is also conducted down into the predawn ionosphere. From the local heat input by the photoelectrons and the conducted heat, temperature profiles were calculated showing the predawn temperature increase. In addition, the predawn enhancement of the 6300-A airflow was calculated. Both the temperature increase and the airglow enhancement are in general agreement with experimental measurements. (auth)

47932 HISTORICAL INTRODUCTION TO AURORA AND MAGNETIC STORMS. Chapman, Sydney (Univ. of Alaska, College. High Altitude Observatory, Boulder, Colo.). Ann. Geophys., 24: 497-505(Apr.-June 1968).

The uncertainties as to the height of the aurora and the misconceptions as to its spectrum, at the time when Birkeland began his work in this field, are indicated; also the mistaken views then current about a connection between the aurora and cirrus clouds. The development of knowledge of magnetic storms up to his time is also briefly told. Birkeland, though greatly interested in the aurora, and active in promoting auroral observations, contributed thereto mainly indirectly, through the stimulus he gave and the auroral interest he aroused in Stormer, Krogness, Vegard, and their successors. His electron beam theories of auroras and magnetic storms were untenable, but he was a leading pioneer in magnetic storm studies at a time when they were much neglected. Through the magnetic records he obtained by his Arctic expeditions, which he coordinated with data from many other observatories, he contributed greatly to the understanding of magnetic storm morphology, and was the first discoverer of the auroral electrojet. (auth)

47933 MAGNETOSPHERE AND MAGNETOSPHERIC SUBSTORM. Akasofu, S.-I. (Univ. of Alaska, College). Ann. Geophys., 24: 507-12(Apr.-June 1968).

It is possible to describe the major aspects of the main phase of geomagnetic storms by using a frequent occurrence of fundamental process, the magnetospheric substorm. The auroral substorm and polar magnetic substorm are but different manifestations of such a fundamental process in the polar upper atmosphere. The formation of the asymmetric proton (storm-time) belt and the proton aurora substorm is also another manifestation of the magnetospheric substorm. (auth)

47934 AURORAL OVAL AND MAGNETIC FIELD IN THE TAIL OF THE MAGNETOSPHERE. Feldstein, Ya. I.; Shevnin, A. D.; Starkov, G. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Ann. Geophys., 24: 517-19(Apr.-June 1968).

A study of the DP and DR influence on the location of an auroral oval was made. Taking into account the auroral oval location a field intensity in the tail of the magnetosphere and its radius was calculated. (auth)

47935 ON THE CHARACTER OF AURORAL GLOW WITHIN THE AURORAL REGION AT PERIODS OF SOLAR ACTIVITY MAXIMUM AND MINIMUM. Evlashin, L. S. (Polar Geophysical Inst., Murmansk, USSR). Ann. Geophys., 24: 521-4(Apr.-June 1968).

The material received during the years 1957–1966 at some Soviet Arctic and Antarctic stations using patrol spectrographs C-180-S, was analyzed. It is shown, that in the years of the solar activity maximum (1957–1959) in the auroral zone (Φ = 60 to 67°) proton aurora (emission Hα) and electron aurora (emission 1 PGN_2) were mainly observed, which during great magnetic disturbances were accompanied by red aurora of the type A (λ 6300 to 6364 Å). In polar caps the most typical in this period was aurora of slight intensity, but in the spectrum of which the red oxygen lines of λ 6300 to 6364 Å predominated. In the years of solar activity minimum (1962–1966) usually proton and electron auroras predominated, but red aurora of type A were not observed. In the polar cap, at least at Mirny (Φ = 77°), the character of auroral glow was changed. According to the observations of 1962 and 1963 aurorae were registered, the spectral characteristics of which were of the same character as that of the auroral zone. (auth)

47936 HYDROGEN EMISSION IN PULSATING AURORAS. Eather, R. H. (Rice Univ., Houston, Tex.). Ann. Geophys., 24: 525-31(Apr.-June 1968).

Simultaneous measurements of electron-excited emissions and Hβ emission during three pulsating auroras (5 to 15 second period) showed no detectable Hβ pulsations. An upper limit for any Hβ modulation is about $\frac{1}{6}$ the percentage modulation of the electron-excited emission. If this result is true in general, it limits possible pulsation mechanisms to those involving plasma instabilities. A single observation of a pulsating aurora with a 50 to 200 second period is also reported; both Hβ and electron-excited λ5577 O I were modulated to the same extent. It is believed a different mechanism was responsible, possibly loss-cone modulation by hydromagnetic waves near the equatorial plane. (auth)

47937 ELECTRON PRECIPITATION FOLLOWING A GEOMAGNETIC STORM SUDDEN COMMENCEMENT. Barcus, James R. (Univ. of Denver). Ann. Geophys., 24: 533-9(Apr.-June 1968).

Balloon observations of bremsstrahlung x rays immediately following the SC at 1202 UT on January 13, 1967, suggest that a substantial part of the electron precipitation had its origin in a local acceleration mechanism which was operative throughout the initial compression phase of the storm. The appearance of an unusual intensity modulation points to strong hydromagnetic-wave coupling, or alternatively, an ordered structure in the solar plasma front encountering the geomagnetic field. (auth)

47938 EFFECT OF A VELOCITY DISPERSION OF THE PRIMARY PARTICLES ON AURORAL LIGHT AND X-RAY PULSATIONS. Pettersen, H. (Auroral Observatory, Tromsoe, Norway); Kvifte, G. L.; Bjordal, J. Ann. Geophys., 24: 541-5 (Apr.-June 1968).

Observations of simultaneous pulsations of x rays and visual aurora show the higher frequencies of the light pulsations to be considerably more damped than the corresponding frequencies of the x-ray pulsations. As the x rays are produced by particles of higher energy than is the auroral light, this difference in damping is interpreted as the effect of a velocity dispersion of the particles. From this difference the modulation mechanism is found to be situated near the magnetic equator. (auth)

47939 OPTICAL AURORAL MORPHOLOGY. Jacka, F. (Univ. of Adelaide); Bond, F. R. Ann. Geophys., 24: 547-53 (Apr.-June 1968).

A very concise account is given of the main features of (1) the gross distribution of discrete visible auroras, (2) the diurnal variation of this distribution represented in terms of the "auroral oval", (3) auroral and magnetic substorms, (4) the mantle aurora, (5) the hydrogen emissions and their relationship to the auroral substorm, and (6) the midlatitude stable auroral red arcs. (auth)

47940 RADIO AURORA: A REVIEW OF RESEARCH IN RADIO AURORA FOR THE PERIOD 1963–1967. Forsyth, P. A. (Univ. of Western Ontario, London). Ann. Geophys., 24: 555-61(Apr.-June 1968).

Experimental and theoretical developments in the field of radio-aurora during the last four years, are reviewed. It is now clearly established that there are two or more fundamentally different types of radio-aurora and studies would be assisted by the adoption of a more uniform nomenclature. The attempts by Unwin and particularly by Hartz and Brice to provide a model for the large-scale characteristics of auroral phenomena may be of great assistance in understanding the more detailed characteristics of radio-aurora. While progress toward an understanding of the scattering mechanism has been slow, the suggestion by Farley that the auroral ionization may support ion–acoustic waves of the kind found in the equatorial E region has stimulated much interest. The present consensus seems to be that ion–acoustic waves are responsible for the observed characteristics of some but not all radio-aurora. There is still a substantial area of disagreement concerning the degree of association between optical aurora and radio-aurora. Suggestions are made regarding the most productive directions for future research. In particular, it is suggested that coordinated observations should be made using rockets, satellites, and ground-based radio and optical equipments. (auth)

47941 AURORAL PARTICLES. Hultqvist, Bengt (Kiruna Geophysical Observatory, Sweden). Ann. Geophys., 24: 563-82(Apr.-June 1968).

A review is given of auroral electron and proton measurements in the last three years. The distribution over the Earth's surface of the precipitation, the flux and energy spectrum of auroral protons, the intensity of electron precipitation, the electron spectrum, correlation between variations in intensity of electron precipitation and in energy spectrum, the pitch-angle distribution, backscattering of particles, velocity dispersion of electrons, high-latitude electron "spikes", and relations between auroral particle precipitation and upper atmosphere effects are treated. Some comments, based on the experimental results reviewed, are made of auroral particle acceleration models. The last three years have brought about a large number of important new experimental results. On the basis of these new data some old ideas have become revitalized and some new ideas have been introduced into the theoretical discussion, which has probed much further into the details of the acceleration mechanisms than before. (auth)

47942 MORPHOLOGY OF MAGNETIC DISTURBANCE. Fukushima, Naoshi; Nagata, Takesi (Tokyo Univ.). Ann. Geophys., 24: 583-93(Apr.-June 1968).

The latitude of maximum geomagnetic activity is on an oval, whose center is shifted from the geomagnetic pole towards the midnight side, similar to the auroral zone. The latitude changes systematically with season on the dayside, while it is almost unchanged on the night side. The equatorward shifting of the oval with increase in magnetic activity is more pronounced on the dayside than near the midnight meridian. The geomagnetic disturbance field D is discussed for convenience by separating it into DCF, DR, and DP. The last term is further decomposed into AEJ (auroral electrojet of sporadic appearance) and SP (enhancement of S_q^p-type field). Worldwide coherent geomagnetic variations are often observed with the S_q^p-like fluctuation. It is remarked that the apparent discrepancy of the equivalent current systems for DP by various investigators are due to the different methods of analysis. The asymmetry of DCF and DR fields in low latitudes of the summer and winter hemispheres is directly connected with the seasonal change in the incident angle of the solar wind streaming around the magnetosphere. The vertical component of the geomagnetic field in high latitudes seems to be greatly influenced by the charged particles incoming from the magnetosphere. (auth)

47943 S_D VARIATION OF THE MAGNETIC FIELD IN HIGH LATITUDES WITH DIFFERENT INTENSITY OF MAGNETIC DISTURBANCES. Feldstein, Ya. I.; Zaitzev, A. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Ann. Geophys., 24: 595-602(Apr.-June 1968).

This paper develops the idea that S_D variation which describes the field of disturbances in high latitudes consists of three parts: S_d^W, S_d^E, S_d^P, where S_d^W and S_d^E are polar electrojets and S_d^P a current vortex in the polar cap. The analysis is made on the basis of considering equivalent current systems set up by the IGY materials. (auth)

47944 PERIODIC FLUCTUATIONS DURING GEOMAGNETIC STORMS IN MIDDLE AND HIGH LATITUDES. Best, A. (Adolf-Schmidt-Observatorium fuer Erdmagnetismus, Niemegk, Ger.). Ann. Geophys., 24: 603-6(Apr.-June 1968).

The results of a statistical frequency analysis of fluctuations in geomagnetic storms are interpreted by using records from middle and high latitudes. It is stated that the power spectra show some preferred periodicities with maxima within the range from 50 to 60 and 90 to 120 minutes in the H component as well as in the D component. By using the same analysis method ionospheric measuring data (A-2 and A-3 method) were also investigated for some selected events. No correlation could be found between the magnetic fluctuations and phenomena in the ionosphere for those events with periods of 20 to 120 minutes. (auth)

47945 WORLDWIDE MAGNETIC SUBSTORMS. Selzer, E. (Faculte des Sciences, Paris). Ann. Geophys., 24: 607-15 (Apr.-June 1968). (In French).

In the present communication, specific characteristics of partial storms are examined and are compared to other phenomena. An attempt is made to explain how the new term "world substorm" best describes their properties in the light of present knowledge. (auth)

47946 ON THE POSSIBILITY OF INFLUENCE OF THE CHANGE IN THE PROPERTIES OF THE LOWER EXOSPHERE RESONANCE CAVITY ON THE FORMATION OF THE IPDP. Troitskaya, V. A.; Maltzeva, N. F. (Inst. of Physics of the Earth, Moscow). Ann. Geophys., 24: 617-19(Apr.-June 1968).

The intervals of pulsations diminishing on periods are observed in the evening hours during magnetic disturbances. The possibility of IPDP generation by streams of particles (protons or electrons) and its formation in the resonance cavity between the ionosphere and the layer of maximum of Alfven velocity has been discussed previously. It is shown, that the changes in the location of the lower boundary of the resonator in the E region, diminishing of electron density in the F2 layer, and the augmentation of F2-layer height behave similar to the diurnal variation of IPDP occurrence. The seasonal displacements of IPDP occurrence and of diurnal variation of the moments of E layer disappearance are similar. The observed changes of characteristics of the lower exospheric boundary can influence the changes in the IPDP frequency range. It is shown that IPDP coincide with the beginning of ionospheric disturbances. It is suggested that the heating of the ionosphere may be due to hydromagnetic waves. In the auroral zone IPDP coincides with occurrence of sporadic layers in the E region and with ionospheric absorption. (auth)

47947 RELATION OF ENERGETIC ELECTRON PRECIPITATION AND GEOMAGNETIC MICROPULSATION TO AURORAL SUBSTORMS. Parks, George K. (Univ. of Minnesota, Minneapolis); McPherron, R. L.; Coroniti, F. V. Ann. Geophys., 24: 621-7(Apr.-June 1968).

Examination of over 600 hours of balloon x-ray and ground-based geomagnetic micropulsation data reveals that these two phenomena, regardless of the local time zones where they are occurring, are intimately related to auroral substorms. The picture that emerged from this study shows that an auroral substorm is often a worldwide disturbance phenomenon and the various temporal forms of auroral zone energetic electron precipitation and magnetic micropulsation events are local time characteristics of this worldwide disturbance phenomenon. Included in this article is also a detailed discussion of the relationship of magnetic micropulsations and energetic electron precipitation. In the light of this study, and those already published regarding correlation of magnetospheric phenomena and auroral substorms, a more inclusive terminology, magnetospheric substorm, is suggested. (auth)

47948 COORDINATED PARTICLE, OPTICAL, AND ELECTRON CONTENT MEASUREMENTS IN AURORAS. Evans, J. E.; Johnson, R. G. (Lockheed Palo Alto Research Lab., Calif.). Ann. Geophys., 24: 629-33(Apr.-June 1968).

Simultaneous measurements of particle fluxes, optical luminosity, and electron content in the auroral zone were made by means of satellite, aircraft, and ground-based instruments. The data were acquired near 08:09 UT (22:14 LT) 9 Nov. 1965 in the vicinity of 67° magnetic latitude and were combined to yield a picture of auroral activity during a relatively quiet period ($\Sigma K_p = 8_9$). The particle detectors on the poleward moving satellite first detected a proton–hydrogen flux with peak energy 0.18 ergs/cm^2 sec and an average energy spectrum which was noticeably harder along the southern edge. Farther north three well separated groups of soft (~1 keV) electrons were detected containing considerably more total energy with a peak flux of ~4 ergs/cm^2 sec. From the particle and luminosity measurements the efficiency for production of H_α in the stable hydrogen arc was calculated to be 0.45%. The electron content measurements correlated well with the observed fluxes of precipitating particles with a maximum of 17×10^{15} electrons/m^2 being ob-

served along the ray path (from satellite beacon at 200 km to receiver in aircraft) through the most intense soft electron peak. (auth)

47949 ROCKET MEASUREMENTS OF THE ENERGY DISTRIBUTION OF SECONDARY ELECTRONS AND ELECTRON TEMPERATURE IN AURORAS. Ulwick, J. C. (Air Force Cambridge Research Labs., Bedford, Mass.). Ann. Geophys., 24: 635-9(Apr.-June 1968).

Probes for the measurement of electron temperature and the energy distribution of secondary electrons were flown on Aerobee Rockets along with other experiments at Churchill, Canada, during the breakup phase of auroras. Two of the rockets were flown a week apart into a diffuse and an active aurora. Two other rockets were fired within thirty seconds of each other into another diffuse aurora. Measurements were made of the low-energy electron spectrums by retarding potential analyzers and of the electron temperatures by Langmuir probes and retarding potential analyzers. The measurements for each individual rocket compare remarkably well in structure but the energies and the temperatures measured in the active aurora showed a large degree of variation or structure compared with the results of the diffuse auroras. The ion production rate is derived from the local integrated flux of electrons above 75 eV. The measured electron temperatures are compared with computed values based on the ion production rate and the electron density. (auth)

47950 AURORAL ELECTRONS. Evans, David S. (Goddard Space Flight Center, Greenbelt, Md.). Ann. Geophys., 24: 641-7(Apr.-June 1968).

The results of rocket studies of the energy spectra of primary auroral electrons are reviewed. Many of these spectra display peaks and discontinuities in the range 3 to 12 keV which indicate, very unambiguously, that these electrons were energized by an electric field. Moreover the observations directly demonstrate that these electrons were trapped on closed field lines restricting the electric field to one that is normal to the magnetic field. Further observations, primarily of electrons of greater than 10 keV, show that a second impulsive acceleration process supplements the basic electrostatic mechanism. A beam–plasma instability is suggested as being the cause of this acceleration and certain features of such a process are outlined. Direct evidence is presented that the dynamic acceleration occurs very close to the atmosphere (1000-km altitude). A working model of the development of an auroral display through the quiet phase to the breakup is advanced based upon these two acceleration mechanisms. (auth)

47951 LOW-ENERGY AURORAL ELECTRON ENERGY SPECTRA AND ANGULAR DISTRIBUTIONS. Reidy, W. P. (American Science and Engineering, Cambridge, Mass.); Hegblom, E. R.; Ulwick, J. C. Ann. Geophys., 24: 649-52(Apr.-June 1968).

Energy spectra and pitch-angle distributions of electrons associated with a visible aurora were measured in a rocket flight from Ft. Churchill, Canada. The electrostatic analyzer used in these measurements covered the range from 2 to 34 keV with an energy resolution of 10% in 350 milliseconds. The angular field of view was $6\frac{1}{2}° \times 16°$ and measurements were made for pitch angles from 20° to 160°. The incident electron energy flux was constant within a factor of two and the spectral shape can be approximated by an exponential with an e-folding value of 5 keV. The pitch-angle distribution measured from 20° to 90° was isotropic within a factor of two. For pitch angles greater than 90° the distribution is energy dependent with the ratio of "reflected" to incident flux decreasing with increasing energy. (auth)

47952 SPECTRA OF CONTINUOUS VLF-EMISSION IN AURORAL ZONE. Ponomarev, E. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Irkutsk, USSR); Vershinin, E. F.; Shapaev, V. I. Ann. Geophys., 24: 653-60(Apr.-June 1968).

A description of experimental apparatus and the methods of obtaining the experimental spectra of continuous vlf-radiation are given. The problem of the influence of propagation conditions in the ionosphere and "Earth–ionosphere" waveguide upon the distribution of spectral density of vlf-radiation flux is examined. The calculation methods are given, as well as examples of spectra calculated for different heights of reflection. The main features of these spectra are: the position of maximum and the relative depth of minimum. These characteristics make it possible to determine the distance to the disturbance point of waveguide and the position of reflected ionospheric layer. The computed spectra are compared with those obtained experimentally. The conclusion is made that the type of spectrum of the continuous vlf radiation at different latitudes is considerably defined by the conditions on the way of its propagation. It is also shown that the primary spectrum of vlf radiation above the absorbing ionospheric region may resemble the spectrum of white noise. (auth)

47953 AURORAL ABSORPTION AT VOSTOK STATION AND ITS RELATED MAGNETIC ACTIVITY. Driatskii, V. M.; Zhigalov, L. N. (Arctic and Antarctic Research Inst., Leningrad). Ann. Geophys., 24: 661-4(Apr.-June 1968).

The events of auroral-type absorption in the area of the south geomagnetic pole are discussed. The radio noise absorption of this type is shown to be concurrent with geomagnetic bays, it it observed only in winter, in the local geomagnetic midnight. The discussed events, as revealed by the results of statistical analysis of the data for a number of years, seem to occur mainly during the intense cosmic magnetic activity. The suggestion is made that certain conditions should develop in the tail of the magnetosphere which accelerate the electron movements and their penetration to the area of the geomagnetic pole. (auth)

47954 VERTICAL STRUCTURE OF DYNAMO WINDS DEDUCED FROM GEOMAGNETIC VARIATIONS ASSOCIATED WITH SOLAR FLARES. Greenfield, Stanley M. (Rand Corp., Santa Monica, Calif.); Venkateswaran, S. V. Ann. Geophys., 24: 665-72(Apr.-June 1968).

In his study of magnetic storms, Birkeland characterized a certain type as "cycle-median." As later pointed out by Chapman, this type of magnetic disturbance is identical to that shown subsequently by McNish and others to be associated with the simultaneous occurrence of solar flares. On the assumption that the magnetic disturbance is due to an enhanced current system in the vicinity of the dynamo region, Chapman suggested that these events should be studied in detail with the hope that such studies might reveal useful information on atmospheric motions in this region. At 1522 UT on August 28, 1966, there occurred a massive solar flare of estimated importance 3B. This flare produced significant disturbances on the magnetograms obtained from some 36 stations distributed throughout the sunlit hemisphere. Much of the major structure observed on these magnetograms occurred with significant simultaneity and correlated well with observed SID events. A detailed time analysis of these records was attempted and equivalent ionospheric current systems calculated for several times beginning with the observed start of the flare. The analysis is consistent with a spectral history of a flare in which the x radiation becomes progressively harder as the flare advances toward maximum. The analysis indicates the existence of vertical variation in the global wind systems in the dynamo region, resulting in a reversal of current in the upper portion of this region. It suggests that the time analysis of SFE represents a new tool for examining the vertical structure of the winds in this region. (auth)

47955 CURRENTS IN THE IONOSPHERE AND MAGNETOSPHERE. Bostroem, Rolf (Royal Inst. of Tech., Stockholm). Ann. Geophys., 24: 681-94(Apr.-June 1968).

Three-dimensional model current systems are discussed, in which magnetospheric and ionospheric sections are connected by currents flowing along the geomagnetic field lines. A model of this kind was first proposed by Birkeland to explain polar elementary storms. Many recent model current systems, such as those proposed for bays and the asymmetric phase of storms, contain field aligned contributions. It has been shown that the currents in these models may produce magnetic perturbations similar to those observed. The elementary physics of the ionospheric–magnetospheric current circuit is discussed, with emphasis on the production of field aligned currents. Among the physical processes that may drive the currents, pressure gradients in a hot magnetospheric plasma seem to be the most powerful if a dipole magnetic field geometry is assumed. However, effects of gradients in the streaming velocity of the plasma may be important in the outer parts of the magnetosphere. (auth)

47956 A SENSITIVE TECHNIQUE FOR DETECTING LATE-TIME ABSORPTION FOLLOWING HIGH-ALTITUDE NUCLEAR EXPLOSIONS. Herman, John R. (Lowell Technological Inst. Research Foundation, Lowell, Mass.). Radio Sci., 3: 964-73 (Sept. 1968).

Variations in atmospheric radio noise intensity measured at Kekaha, Hawaii, are used to detect long-lasting ionospheric absorption produced by late-time, radioactive debris deposited in the upper atmosphere by the high-altitude nuclear explosions Star Fish and King Fish. Variations in noise source intensity and location, combined with variations in radio propagation conditions between the source and receiver, describe the observed variations in received noise power at a distant station. At Kekaha, the noise level on frequencies between 0.5 and 5.0 MHz was depressed for about four nights following each explosion. The depression is explained by the existence of a low-intensity absorbing

region occupying a wide geographic area that effectively fills a major portion of the omnidirectional antenna beam employed at the noise receiving station. (auth)

47957 COMPARISON OF METHODS FOR CALCULATING LF AND VLF REFLECTION COEFFICIENTS. Gambill, Burt (General Electric Co., Santa Barbara, Calif.). Radio Sci., 3: 954-64(Sept. 1968).

This paper compares methods for computing reflection coefficients for lf and vlf radio waves that are obliquely incident on a horizontally stratified medium. A recursive technique requiring a digital computer is used for reference calculations. This method is compared with two approximate methods that are suitable for use with hand or graphical calculations. Ionospheric profiles that result in reflection from very diffuse and depressed regions are considered. It is shown that for a great variety of disturbed conditions the approximate techniques are adequate for predicting reflection coefficient magnitude. (auth)

47958 GENERATION OF AN ATMOSPHERIC WAVE IN AN AURORAL DISTURBANCE. French, A. G. (Dept. of Scientific and Industrial Research, Christchurch, New Zealand). Planet. Space Sci., 16: 993-7(Aug. 1968).

A mechanism is postulated for generating an atmospheric wave by an auroral disturbance traveling at supersonic speeds. From a study of auroral all-sky camera, magnetic and ionospheric records for 19 July 1958, this mechanism is illustrated. (auth) (UK)

47959 RADIOASTRONOMICAL STUDIES OF THE VELOCITY AND SIZE OF SMALL-SCALE INHOMOGENEITIES OF THE INTERPLANETARY PLASMA. Vitkevich, V. V.; Vlasov, V. I. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR, 181: 572-4(July 21, 1968). (In Russian).

Fast changes in intensity of radio emission (flickers) were measured at three points of an equilateral triangle 220 km on a side. Readings were taken simultaneously at synchronized times on radiotelescopes having effective antenna areas of about 1000 m^2. The relative time shifts were determined from the maxima and minima of the amplitude fluctuations. From the known geometry of the point and the time shifts it was possible to calculate a velocity of 280 to 300 km/sec and an average size of 380 km for these inhomogeneities emitted from the 3C-48 radio source in the first half of 1967. The electron concentration above the average value was calculated to be $\Delta N \sim 2 \times 10^{-2}$ for an angle $\phi \sim 40°$. (TTT)

47960 PLASMA FLOW IN THE MAGNETOSPHERE. Kavanagh, L. D. Jr.; Freeman, J. W. Jr.; Chen, A. J. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 5511-19(Sept. 1, 1968).

A mathematical model of the magnetosphere was constructed in which a large-scale uniform electric field, representing plasma flow from the tail, is superimposed on the geomagnetic field. In addition, the model includes a corotation electric field and an electric field resulting from the conductivity of the plasmasphere. Drift paths of charged particles with various energies are traced out in the equatorial plane, assuming that these particles may enter the magnetosphere through the tail. It is found that an electric field of 0.3 mV/m (across the tail) forms a forbidden zone for thermal particles that is approximately the size and shape of the plasmasphere. The electric field model is also found to provide a qualitative explanation for such varied phenomena as asymmetric ring currents, field-aligned currents in the magnetosphere, and the existence of an abrupt inner termination to the plasma sheet. The presence of return flow of plasma near the magnetopause resulting from a viscous interaction with magnetosheath plasma is discussed, and it is argued that the return flow does not affect the electric field picture except very near the boundary. (auth)

47961 IDENTIFICATION OF MOVING MAGNETIC FIELD LINES. Birmingham, Thomas J.; Jones, Frank C. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 5505-10(Sept. 1, 1968).

Magnetic field line motion and its relationship with particle $E \times B$ drifts are considered. It is shown that a unique and significant field line identification can be made whenever all field lines in a region pierce a conducting, but arbitrarily shaped surface. If the region in question is free space, particle electric drifts, in general, bear no relation with field line motion identified in this fashion. However, with a conducting plasma filling the region and allowing no parallel component of electric field ($E \cdot B = 0$), particles drift so as to always remain on the same magnetic line of force. These points are specifically illustrated for a time-dependent model of the Earth's magnetosphere. (auth)

47962 THERMAL IONS IN THE EXOSPHERE: EVIDENCE OF SOLAR AND GEOMAGNETIC CONTROL. Taylor, H. A. Jr.; Brinton, H. C.; Pharo III, M. W.; Rahman, N. K. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 73: 5521-33 (Sept. 1, 1968).

Direct measurements of a pronounced latitudinal variation in the exospheric ion composition have been obtained from the rf ion spectrometer experiment on OGO 2. Measurements of thermal positive ions obtained in a nearly polar dawn–dusk orbit during mid-October 1965, show that in the altitude range of 415 to 1525 km the major ions are O^+ and H^+, and the minor constituents are N^+ and He^+. Consistent with this period of low solar activity, He^+ is at all altitudes a minor ion, relative to H^+. Evidence of pronounced solar and geomagnetic control of the ion distributions is further examined by translating the data along magnetic field lines to both (1) a constant 1000 km reference level and (2) the dipole equator, applying chemical and diffusive equilibrium theory. At 100 km O^+ dominates in both the northern and southern polar ionospheres, yielding at lower latitudes where H^+ dominates. The resultant mean ion mass distribution, about 14 to 16 amu at the poles, and about 4 amu at the equator, is generally consistent with theory and other measurements. The latitudinal asymmetry in the distributions of O^+ and N^+ reflects the control of seasonal temperature differences, while the greater symmetry in the distributions of H^+ and He^+ reveals the strong influence of solar–geomagnetic control of the light ions. The high-latitude ionosphere is marked by two dominant features: (1) a persistent, major trough in $n(H^+)$ and $n(He^+)$ where $n(H^+)$ drops to about 10^2 ions/cm^3 near 60° dipole and (2) a variable poleward peak in which the total ion concentration N_i approaches 10^4 ions/cm^3 near 80° dipole. The pronounced light ion trough, which correlates well with the whistler cutoff, is believed to mark the high-latitude boundary of the thermal plasma that diffuses upward along closed field lines to populate the plasmasphere. Poleward of the trough, the strong fluctuations in the composition and the variability of the amplitude and position of the ionization peak suggest that the polar exosphere is decoupled from the plasmasphere and is probably linked with the solar wind–magnetospheric tail system. Comparison of the extrapolated equatorial N_i profile with thermal ion distributions measured directly in the magnetosphere further supports this interpretation. (auth)

47963 INTENSITY PROFILES OF THE 6300-A AND 5577-A ATOMIC OXYGEN LINES IN THE NIGHT AIRGLOW. Gulledge, I. S.; Packer, D. M.; Tilford, S. G.; Vanderslice, J. T. (Naval Research Lab., Washington, D. C.). J. Geophys. Res., 73: 5535-47(Sept. 1, 1968).

Altitude profiles of the 5577- and 6300-A neutral oxygen nightglow radiations were observed with rocket photometers to an altitude of 258 km. Five hours after sunset, the 6300-A red line exhibited an intensity maximum at approximately 245 km. The 5577-A green line also exhibited a second intensity maximum at this same altitude in addition to the lower peak at 97 km. The high-altitude green line intensity was about $\frac{1}{3}$ that of the red line intensity at the same altitude and about $\frac{1}{10}$ that of the 5577-A layer at 97 km. The dissociative recombination reaction of O_2^+ is the only mechanism required to explain the observed profiles. Upper limits for the specific dissociative recombination coefficients of $O(^1S) \approx 1.1 \times 10^{-8}$ cm^3 sec^{-1} and $O(^1D) \approx 3.5 \times 10^{-8}$ cm^3 sec^{-1} were derived from these nightglow observations. An upper limit of $\approx 1 \times 10^{-11}$ cm^3 sec^{-1} was obtained for the collisional deactivation coefficient of $O(^1D)$ with the assumption that molecular nitrogen is the principal deactivating species in the upper atmosphere. (auth)

47964 COHERENCE OF GEOMAGNETIC DP 2 FLUCTUATIONS WITH INTERPLANETARY MAGNETIC VARIATIONS. Nishida, Atsuhiro (Tokyo Univ.). J. Geophys. Res., 73: 5549-59(Sept. 1, 1968).

From the comparison of the worldwide geomagnetic data with IMP 1 magnetic records obtained in interplanetary space, it is found that the DP 2 fluctuations, which are thought to be the geomagnetic counterpart of intensity fluctuations of the magnetospheric convective system, are coherent with variations in the north–south component of the interplanetary magnetic field. This coherence is observed irrespective of whether this component is directed northward or southward. Average time delay between the crossing of an interplanetary magnetic structure across the nose of the bow shock and the associated magnetic variation on the ground is 7 minutes at the pole and 9 minutes at the midday equator. Applicability of the proposed models of the magnetospheric electric field to this phenomenon is critically examined, and the penetration of the interplanetary electric field into the magnetosphere is suggested as the origin of the DP 2 phenomenon. (auth)

47965 TRANSFER PROCESSES IN THE MAGNETOPAUSE. Eviatar, Aharon (Bell Telephone Labs., Murray Hill, N. J.); Wolf, R. A. J. Geophys. Res., 73: 5561-76(Sept. 1, 1968).

The magnetic-field fluctuations observed in the vicinity of the magnetopause boundary layer imply a substantial transfer of particles and momentum from the solar wind to the magnetosphere. The observed noise with frequencies near the proton cyclotron frequency indicates that protons in the boundary layer can diffuse across field lines at a rate of one proton gyroradius every few cyclotron periods. It is suggested that the enhanced noise level near the magnetopause is caused by a two-stream cyclotron instability in the magnetopause. The equilibrium level of fluctuations is estimated using quasi-linear theory; the result is found to be consistent with observations. It is concluded that fluctuations must play an essential role in determining the structure of the magnetopause. The rate of momentum transfer across the magnetopause is estimated in order of magnitude and is found to be approximately equal to the value needed to produce the magnetospheric convection postulated by Axford and Hines, Brice, and others. (auth)

47966 RAY TRAJECTORIES IN AN ANISOTROPIC PLASMA NEAR PLASMA RESONANCE. McAfee, J. R. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 73: 5577-83(Sept. 1, 1968).

Slow waves, which are greatly modified by small changes in the plasma parameters, occur near the plasma frequency. They may be obliquely reflected for the case of an electron concentration gradient orthogonal to the magnetic field, traveling only a short distance but experiencing a large delay. Such waves may account in part for the resonances observed by ionospheric topside sounders. (auth)

47967 REVISED THEORY FOR PARTIAL REFLECTION D-REGION MEASUREMENTS. Flood, W. A. (Cornell Aeronautical Lab., Inc., Buffalo). J. Geophys. Res., 73: 5585-98(Sept. 1, 1968).

A theory for the backscattering cross section of hf waves from electron concentration fluctuations in the D region is developed. The resulting expression is seen to differ from that developed by Gardner and Pawsey and by Belrose and Burke because these workers have neglected the effects of differential absorption within the scattering volume. The consequences of this revised theory in the interpretation of the results of "partial reflection" measurements of D-region profiles are discussed and illustrated. It is shown that the electron concentration profiles previously deduced from partial reflection data could be in error, although the general shape of the electron concentration profile is unchanged. (auth)

4 LATITUDE VARIATION OF ELECTRON CONTENT IN EQUATORIAL REGION UNDER MAGNETICALLY QUIET AND ACTIVE CONDITIONS. Basu, S.; Das Gupta, A. (Calcutta Univ.). J. Geophys. Res., 73: 5599-5602(Sept. 1, 1968).

Faraday rotation data from the beacon satellite S-66 obtained at Haringhata Field Station (dip 32°N) of the University of Calcutta were used to compute the variation of electron content with latitude under magnetically "quiet" and "active" conditions. On a quiet day, the latitudinal variation of electron content is regular and pronounced, showing a maximum around a magnetic dip 33°N. On an active day, the electron content anomaly is nearly absent, and the peak is flattened out and shifted toward the magnetic equator. The results can be explained on the basis of a reduced vertical plasma drift velocity in the ionosphere at the magnetic equator on a magnetically active day as compared to a quiet day. (auth)

47969 VARIATIONS OF PLASMA SCALE HEIGHT IN THE UPPER IONOSPHERE DURING THE SUNRISE PERIOD. McInnes, B. A. (Stanford Univ., Calif.). J. Geophys. Res., 73: 5603-13(Sept. 1, 1968).

Alouette 1 topside soundings have been used to study predawn variations of plasma scale height for different seasons and altitudes. Plots of average plasma scale height against solar zenith angle show a difference in behavior for altitudes above and below 550 km, for solar zenith angles greater than 95°. Above 550 km there is an initial increase in plasma scale height that occurs at progressively higher solar zenith angles as the season changes from summer through equinox to winter. Subsequently, as the solar zenith angle changes from 105° to 95°, the plasma scale height decreases to its lowest value of the day. Below 550 km the plasma scale height is initially constant and then steadily increases during the period between solar zenith angles 105° and 95°. For solar zenith angles less than 95°, the behavior is of two types, either a sharp peak in the plasma scale height values, which is most pronounced at high altitudes, or fairly constant scale-height values with a small altitude gradient in these values. It is shown that for the midnight and midday conditions the seasonal and altitude variations in plasma scale height can be explained in terms of the values of plasma temperatures, temperature gradients, and mean ionic masses. The way in which the values of the three quantities change during the sunrise period is studied, and it is seen that these changes can account for the plasma scale-height variations during this time. Seasonal variations are explained in terms of photoelectron production in the conjugate ionosphere and possibly in the protonosphere. For solar zenith angles less than 95°, the plasma scale-height variations are in agreement with the temperature changes predicted by da Rosa [1966]. (auth)

47970 MORPHOLOGY OF VLF EMISSIONS OBSERVED WITH THE INJUN 3 SATELLITE. Taylor, William W. L.; Gurnett, Donald A. (Univ. of Iowa, Iowa City). J. Geophys. Res., 73: 5615-26(Sept. 1, 1968).

Results of a study of very-low-frequency emissions observed with the Injun 3 satellite are presented. Approximately 1200 hours of vlf magnetic field strength data and approximately 6000 frequency spectra samples were investigated in this study. These data cover invariant latitudes up to 82°, all local times, and altitudes from 237 to 2785 km. Contour plots as a function of invariant latitude and magnetic local time giving the frequency of occurrence of vlf emissions above a given intensity are presented. The most intense vlf emissions observed by Injun 3 were found to occur between about 55 and 75° invariant latitude and during the local day, with the maximum intensity occurring at about 65° invariant latitude and about 8 to 10 hours magnetic local time. The region of most intense vlf emissions was found to move to lower latitudes during geomagnetically active periods. The principal types of vlf emissions occurring in this region are elf hiss and chorus, with the elf hiss usually being the most intense. (auth)

47971 PHYSICAL SIGNIFICANCE OF THE E_s PARAMETERS f_bE_s fE_s, AND f_oE_s. 2. CAUSES OF PARTIAL REFLECTIONS FROM E_s. Reddy, C. A. (High Altitude Observatory, Boulder, Colo.). J. Geophys. Res., 73: 5627-47(Sept. 1, 1968).

Simultaneous observations of midlatitude E_s by rockets and ionosondes show that the rocket-measured peak electron concentration in E_s usually corresponds to the blanketing frequency f_bE_s and almost never to the so-called "critical frequency" f_oE_s, except when $f_oE_s \approx f_bE_s$. The latter observation suggests that the often postulated "overdense" E_s blobs with peak electron concentrations corresponding to f_oE_s do not exist; or at any rate, they are not as common as the occurrence of large f_oE_s values would suggest. Theoretical calculations based on simplified but realistic models show that partial reflections from sharp electron concentration gradients or scattering from small-scale weak irregularities in E_s can produce partially reflected E_s echoes of sufficient intensity over large frequency ranges above f_bE_s. Therefore, it is concluded that the above two processes are predominantly responsible for partial reflections from E_s, and both the processes may be quite often subject to the influences of ionospheric absorption and equipment sensitivity. It is suggested that the variations of fE_s (or f_oE_s derived from it) contain unresolved information on the variations of E_s ionization, the gradients and irregularities in the E_s ionization, and the ionospheric absorption effects on the partial reflections from E_s. The implications of these conclusions in relation to the wind shear theory of E_s are discussed. The need for great caution in using fE_s in any physical study of E_s, and the redundancy of the deduced E_s parameter f_oE_s are pointed out. (auth)

47972 VLF ELECTRIC AND MAGNETIC FIELDS OBSERVED WITH THE JAVELIN 8.45 SOUNDING ROCKET. Shawhan, Stanley D.; Gurnett, Donald A. (Univ. of Iowa, Iowa City). J. Geophys. Res., 73: 5649-64(Sept. 1, 1968).

A rocket vlf experiment flown from Wallops Island to an altitude of 763 km is described, and the experiment results are discussed. A noise band between about 7.5 and 30 kHz was observed with both the electric and magnetic receivers. The field geometry of this noise suggests that the noise is propagating perpendicular to the geomagnetic field and that the lower cutoff frequency may be the lower hybrid resonance frequency. Intense noise bursts below 1 kHz were observed on the electric antennas below 500-km altitude during both the upgoing and downgoing portions of the flight, but not on the loop antennas. The precession and spin modulation of this noise is not consistent with an interpretation of these noise bursts as being due to long wavelength electrostatic waves in the surrounding plasma. It is suggested that this electric antenna noise may be generated by the motion of the payload. The magnitude of the electric antenna impedance varied from a minimum of about 150 kilohms at 350-km altitude to about 600 kilohms at apogee. A large phase perturbation, usually inductive, was observed at altitudes below about 500 km whenever the antenna was aligned nearly parallel to the geomagnetic field. The electric field signal from the nosecone transmitter was attenuated much more rapidly than the magnetic field. (auth)

47973 LIFETIMES FOR LOW-ENERGY PROTONS IN THE OUTER RADIATION ZONE. Swisher, R. L.; Frank, L. A.

(Univ. of Iowa, Iowa City). J. Geophys. Res., 73: 5665-72 (Sept. 1, 1968).

The directional, differential intensities of protons over the energy range ~200 eV to 50 keV injected into the outer radiation zone (i.e., the extraterrestrial ring current) coincident with the initial phase of the geomagnetic storm during early July 1966 were monitored with a sensitive array of electrostatic analyzers borne on OGO 3. Proton intensities are greatly enhanced throughout the outer radiation zone for L values $\gtrsim 3$ during the main phase of this moderate magnetic storm, and the injection mechanism ceases to be effective after the storm main phase for L values $\lesssim 5.5$. Proton ($30 \leq E \leq 50$ keV) intensities are shown to exponentially decay with lifetimes ranging from 15 to 105 hours in substantial agreement with calculated lifetimes invoking measured charge-exchange cross sections for protons incident upon atomic hydrogen and a model of the atomic hydrogen concentration in the exosphere. The atomic hydrogen concentration model for the exosphere providing the best fit to the observed proton lifetimes over geocentric radial distances 2.5 to 4.8 R_E (corresponding to observed concentrations ~200 to 30 hydrogen atoms/cm^3) allows only atoms in ballistic orbits in the exosphere as opposed to a model geocorona that includes an additional atomic hydrogen population in captive elliptical orbits. (auth)

47974 OBSERVATIONS OF TRAPPED ELECTRONS AT LOW AND HIGH ALTITUDES. Williams, D. J. (Goddard Space Flight Center, Greenbelt, Md.); Arens, J. F.; Lanzerotti, J. L. J. Geophys. Res., 73: 5673-96(Sept. 1, 1968).

Energetic ($\gtrsim 280$ keV, $\gtrsim 1$ MeV) trapped electron intensities have been simultaneously obtained at low and high altitudes for a 6-month period in 1965 by the satellites 1963 38C and Explorer 26. The data show that the $\gtrsim 280$-keV electron population attains equilibrium within a flux tube after a magnetic storm significantly faster than do the $\gtrsim 1$-MeV electrons. Mechanisms leading to the equilibrium state are therefore less effective at the higher energies. An example of this is given in terms of pitch-angle scattering by whistler mode noise. The comparison of particle response characteristics at low and high altitudes during a main phase storm also is used to obtain a rough measure of field expansion in the storm. In addition energetic electrons associated with main phase magnetic storms are observed to appear initially at L values well within the trapping regions and subsequently diffuse to lower and higher altitudes. The region of appearance of these electrons is strongly correlated with D_{st} magnitude. Preliminary results indicate that the acceleration mechanisms responsible for the appearance of these energetic electrons act on the high-altitude side of the whistler knee. The appearance of energetic electrons in the trapping regions from the equator to low altitudes during the April 17, 1965, storm also correlates very well spatially with an observed depletion of maximum ionospheric electron density NmF_2. (auth)

47975 PENETRATION OF THE MAGNETOPAUSE BEYOND 6.6 R DURING THE MAGNETIC STORM OF JANUARY 13–14, 1967: INTRODUCTION. Opp, Albert G. (National Aeronautics and Space Administration, Washington, D. C.). J. Geophys. Res., 73: 5697-8(Sept. 1, 1968).

During the magnetic storm of January 13 and 14, 1967, the magnetopause was detected at 6.6 R_E by instruments on the ATS 1 satellite. This is believed to be the first case in which the magnetopause has been observed to penetrate within 6.6 R_E of the Earth. ATS 1 was launched on December 6, 1966, into an equatorial synchronous orbit. The satellite was positioned at 150°W and was located at 1400 local time when the magnetopause was first detected. (auth)

47976 MAGNETIC FIELDS IN THE MAGNETOPAUSE AND VICINITY AT SYNCHRONOUS ALTITUDE. Cummings, W. D.; Coleman, P. J. Jr. (Univ. of California, Los Angeles). J. Geophys. Res., 73: 5699-5718(Sept. 1, 1968).

At 0007 UT on January 14, 1967, the magnetopause was detected at 6.6 R_E with ATS 1. Several boundary crossings were recorded during the succeeding hour as the spacecraft local time changed from 1400 to 1500. The magnetic fields in the magnetopause and on both sides of this boundary were measured during this 1-hour interval. The normal to the boundary at the first crossing was 5° from the equatorial plane projection of the Earth–Sun line, indicating that the magnetopause was flattened appreciably. In general, the boundary normal was nearly radial from the Earth during most of the interval. The field strength in the magnetosheath was initially 165 γ. The mean value of the magnetosheath field strength for the period was 123 γ. The magnetospheric field strength varied from 165 γ just before the first boundary crossing to 210 γ just after the last crossing; the mean value for the interval was 176 γ. The measured quiet-day field strength at this location is about 124 γ. The ratio of the particle kinetic energy density to the magnetic energy density just inside the boundary at the time of the first crossing is estimated to have been greater than 0.8. Most of the particles apparently left this region during the interval between the first and last magnetopause crossings. The fluctuations in the magnetosheath in the range 0 to 0.1 Hz were predominantly compressional, while those in the range 0.2 to 0.8 Hz were predominantly transverse to the mean field. In the magnetosphere transverse fluctuations were predominant at all but the lowest frequencies. The power below 0.8 Hz in the magnetosheath fluctuations was nearly 50 times greater than that in the magnetosphere just before the first crossing. The power in the fluctuations in the magnetospheric field also increased after this event by a factor of about 10. No evidence was found for rotational discontinuities at the magnetopause, whereas a number of relatively clear tangential discontinuities were identified. Thus, despite the fact that the prerequisite solar-wind conditions for field-line merging were satisfied, including the southward orientation of the interplanetary field, the observed field behavior at the magnetopause was not consistent with an open magnetosphere. Thus, despite the fact that the prerequisite solar-wind conditions for field-line merging were satisfied, including the southward orientation of the interplanetary field, the analysis failed to yield evidence for the rotational discontinuities that would presumably be required at the magnetopause in this case. (auth)

47977 PLASMA FLOW DIRECTIONS AT THE MAGNETOPAUSE ON JANUARY 13 AND 14, 1967. Freeman, J. W. Jr.; Warren, C. S.; Maguire, J. J. (Rice Univ., Houston, Tex.). J. Geophys. Res., 73: 5719-31(Sept. 1, 1968).

On January 13 and 14, 1967, ATS 1 was in close proximity to the magnetopause for a sustained period of time. In addition to the pure magnetosheath and pure magnetospheric ion flow patterns, a new component of ion flow was found immediately inside the magnetospheric boundary. This flow had characteristics nearly identical to the magnetosheath ion flow; the flow was parallel to the boundary in the downstream direction, and the total ion flux was nearly the same as that found across the boundary in the magnetosheath. Because of its persistence to substantial depths within the magnetosphere, this new flow component is thought to be the "return" flow (to the magnetotail) for the magnetospheric thermal plasma found to be convecting sunward more deeply within the magnetosphere. The magnetospheric flow pattern during this event then becomes generally consistent with that suggested by Axford and Hines. (auth)

47978 STRUCTURE OF THE MAGNETOPAUSE AT 6.6 R_E IN TERMS OF 50- TO 150-keV ELECTRONS. Lezniak, T. W.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 73: 5733-42(Sept. 1, 1968).

Measurements were made with a magnetic deflection electron spectrometer of electrons in the range 50 to 150 keV at the boundary of the magnetosphere on January 14, 1967. At this time, the magnetopause was compressed inside the orbit of ATS 1, which was located at 6.6 R_E in the subsolar region of the magnetosphere. The first crossing of the trapping boundary and magnetic field reversal was followed by many transient count rate increases and magnetic field variations. Owing to the rapid sampling of electrons on the spinning satellite it was possible to determine the azimuthal distribution associated with electron concentration gradients at the various boundaries and to determine the direction in space of the gradients and of the trapping boundary surfaces. In one case the trapping boundary was found to be approximately perpendicular to the Earth's surface. In another case a transient region was found that appeared to be moving over the spacecraft from the solar direction. The energetic electron trapping boundary was usually separated from the magnetic field reversal by the order of four cyclotron radii. The electron flux dropped from 1.4×10^4 to 3.2×10^2 (electrons cm^{-2} sec^{-1} ster^{-1} keV^{-1}) in two cyclotron radii at one of these boundaries. (auth)

47979 BOUNDARY OF ENERGETIC ELECTRONS DURING THE JANUARY 13–14, 1967, MAGNETIC STORM. Paulikas, G. A.; Blake, J. B.; Freden, S. C.; Imamoto, S. S. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 73: 5743-50 (Sept. 1, 1968).

Measurements of energetic electron fluxes were made aboard ATS 1 during the magnetic storm of January 13–14, 1967. Between 0007 and about 0105 UT (approximately 1400 to 1500 local time) on January 14 the electron fluxes dropped to background levels in a manner, which, when associated with the on board magnetometer data, suggests that the boundary of the magnetosphere was compressed to less than 6.6 R_E on the day side of the magnetosphere. (auth)

47980 ENERGETIC ELECTRONS AT 6.6 R_E DURING THE JANUARY 13–14, 1967, GEOMAGNETIC STORM. Lanzerotti,

L. J.; Brown, W. L.; Roberts, C. S. (Bell Telephone Labs., Murray Hill, N. J.). J. Geophys. Res., 73: 5751-60(Sept. 1, 1968).

The trapped, energetic (E_e > 0.4 MeV to >3.0 MeV) electron fluxes at synchronous altitude are examined during the January 13–14, 1967, geomagnetic storm. Except for a short period after the sudden commencement (sc) at 1202 UT, day 13 (0202 local time), the measured electrons were observed to be stably trapped for about the first twelve hours after the sc. However, the values of the electron fluxes in the local morning and at local noon were quite different than those generally observed during quiet periods. About two hours after local noon, at 2324 UT, day 13, the electron flux dropped sharply by two orders of magnitude in response to a sudden decrease in the magnetic field observed at the satellite. Recovery of the electron flux occurred in a few minutes. About 40 minutes later, 0007 UT, day 14, the electron fluxes were essentially wiped out at the time of an observed reversal in the magnetic field at the satellite. During two separate approximately 10-minute periods after this 0007 UT, day 14, wipeout, the observed particle fluxes indicate that the satellite encountered a region of space with characteristics very different from the normal magnetospheric trapping region. The data during these times are consistent with the interpretation from the magnetic field observations that the satellite was outside the magnetopause. Correlation of the electron data during the storm is made with the satellite magnetometer data and with the magnetometer data from several ground stations. (auth)

47981 SOLAR WIND AND MAGNETOSHEATH OBSERVATIONS DURING THE JANUARY 13–14, 1967, GEOMAGNETIC STORM. Bame, S. J.; Asbridge, J. R.; Hundhausen, A. J.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 73: 5761-7(Sept. 1, 1968).

The interplanetary, magnetosheath, and magnetotail plasmas were observed with electrostatic analyzers on the Vela 3A and 3B satellites at ~18 R_E during the January 13–14, 1967, geomagnetic storm. Various parts of the storm phenomenology were observed. The sudden commencement at 1202 UT on January 13 was caused by an interplanetary shock that passed the Earth with a speed of ~463 km sec^{-1}, considerably lower than the probable average propagation speed from the Sun of ~720 km sec^{-1}. During the initial phase and main phase development the magnetotail was either compressed or tilted up, or both. Just before the inward movement of the magnetopause observed with ATS 1 the solar wind velocity decreased and suddenly increased again by ~55 km sec^{-1}. During the main phase development the solar wind plasma population as observed by the Vela satellites was distinctly different from the initial phase population, as shown by the arrival of plasma with substantially increased density and alpha particle abundance. Near the peak of the main phase and later, magnetopause crossings showed that the magnetosphere was inflated. (auth)

47982 OGO 3 SEARCH COIL MAGNETOMETER DATA CORRELATED WITH THE REPORTED CROSSING OF THE MAGNETOPAUSE AT 6.6 R_E BY ATS 1. Russell, Christopher T. (Univ. of California, Los Angeles); Olson, John V.; Holzer, Robert E.; Smith, Edward J. J. Geophys. Res., 73: 5769-75(Sept. 1, 1968).

OGO 3 passed from the outer magnetosphere through the magnetosheath and into the interplanetary medium between 2200 UT, January 13, and 0300 UT, January 14, 1967. This interval includes the time during which the ATS 1 satellite reportedly encountered the magnetopause and magnetosheath at 6.6 R_E. Nearly two hours before the ATS 1 event the OGO 3 search coil magnetometer recorded a normal magnetopause crossing. About half an hour later a sudden increase in the steady magnetic field to an unusually large amplitude for a magnetosheath field was observed. Then, within a minute of the first reported ATS 1 magnetopause crossing, an increase in the amplitude of the magnetic noise was noted. Finally, about 45 minutes after the first ATS 1 crossing the bow shock was crossed at a position that was extremely close to the Earth. An analysis of the OGO 3 search coil data fully supports the interpretation of the unusual ATS 1 records as displacements of the magnetopause inside of the ATS 1 orbit. (auth)

47983 OUTWARD FLOW OF PROTONS FROM THE EARTH'S BOW SHOCK. Asbridge, J. R.; Bame, S. J.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res., 73: 5777-82(Sept. 1, 1968).

Vela measurements are presented demonstrating that positive ions from the solar wind are often accelerated at the bow shock and emitted outward into the free-flowing wind. (W.D.M.)

47984 ACCELERATION OF ENERGETIC ELECTRONS OBSERVED AT THE SYNCHRONOUS ALTITUDE DURING MAGNETOSPHERIC SUBSTORMS. Parks, G. K.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 73: 5786-91(Sept. 1, 1968).

The properties of energetic electron flux variations measured at the 6.6 R_E equatorial plane by the electron spectrometer on board ATS 1 have been studied, and the results are discussed. The results of correlation studies made between the equatorially trapped electrons and the precipitated energetic electrons measured by means of bremsstrahlung x rays near the magnetic conjugate region of the satellite are also discussed. (W.D.M.)

47985 EXPERIMENTAL OBSERVATION OF A LARGE ADDITION TO THE ELECTRON INNER RADIATION BELT AFTER A SOLAR FLARE EVENT. Pfitzer, K. A.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 73: 5792-7(Sept. 1, 1968).

The magnetic disturbance after the Sept. 2, 1966, solar flare injected electrons into the inner zone to L's as low as 1.3. The data for this event covered equatorial pitch angles from $\alpha_0 = 30°$ to $\alpha_0 = 60°$. This pitch-angle dependence was removed and the data normalized to $\alpha_0 = 90°$. The expanded time history of the event for various L's for the 290- to 690-keV energy channel is shown. (W.D.M.)

47986 SEASONAL VARIATION OF MOLECULAR OXYGEN NEAR 100 KILOMETERS. Norton, R. B.; Warnock, J. M. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 73: 5798-5800(Sept. 1, 1968).

In the Earth's atmosphere solar hydrogen Lyman α is absorbed almost entirely by molecular oxygen. Therefore, to study possible systematic variations of O_2 near 100 to 120 km, a number of attenuation profiles of Lyman α were collected and analyzed. These profiles were obtained with a photometer aboard SOLRAD 8. (W.D.M.)

47987 NOTE ON MODE CONVERSION AT VLF IN THE EARTH–IONOSPHERE WAVEGUIDE. Wait, James R. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 73: 5801-4(Sept. 1, 1968).

Theoretical work on mode conversion in the Earth–ionosphere waveguide has been based essentially on two-dimensional formulations. Although the calculated scattering coefficients are of the right order of magnitude, some basic questions concerning the conversion mechanism are left unanswered. In this note, the problem is considered from a different standpoint. In particular, the extent of the sunrise line that gives rise to the mode conversion is considered. (W.D.M.)

47988 DISCUSSION OF PAPER BY HAROLD E. TAYLOR AND EDWARD W. HONES, JR., "ADIABATIC MOTION OF AURORAL PARTICLES IN A MODEL OF THE ELECTRIC AND MAGNETIC FIELDS SURROUNDING THE EARTH". Vasyliunas, Vytenis M. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res., 73: 5805-8(Sept. 1, 1968).

The inclusion of the Pedersen conductivity by Taylor and Hones is challenged by the author. A reply by Taylor and Hones is included. (W.D.M.)

47989 IONOSPHERIC MEASURING PROBE. 3. Miyazaki, Shigeru; Mori, Hirotaka (Radio Research Lab., Tokyo). Tokyo Daigaku Uchu Koku Kenkysuho Hokoku, 4: 368-75(July 1968). (In Japanese).

Basic ionospheric parameters such as electron density, electron temperature, ion density, ion temperature, space potential, etc., have previously been measured by an individual probe system in use with the space vehicles. However, it is necessary to measure all the ionospheric parameters at the same time by a single probe assembly especially for detailed comparison between the parameters or for measurement of the ion density when there are many ion species in the ionosphere. This paper describes the method of measuring the electron density, electron temperature, plasma space potential relative to vehicle potential, ion composition, and ion temperature at the same time by the use of Faraday-cup-type probe assembly. This method of measurement is considered for the purpose of obtaining all the ionospheric parameters self-consistently and accurately. (auth)

47990 AURORAL ABSORPTION ZONE IN THE SOUTHERN HEMISPHERE DURING MAXIMUM SOLAR ACTIVITY. Gorbushina, G. N. (Arctic and Antarctic Scientific Research Inst., Vostok Station, Leningrad); Zhulina, E. M. Sov. Antarct. Exped. Inform. Bull., 6: 370-3(Mar. 1968).

The latitudinal (average annual) frequency distributions of anomalous absorption ($P_a^{\%}$) for Northern and Southern Hemisphere stations were compared. The results obtained in the 2 hemispheres were rather similar, i.e., the zones in question (northern and southern) were located at the same corrected geomagnetic latitudes. But the frequency of anomalous absorption at the max-

imum was several per cent higher in the Southern than in the Northern Hemisphere. The frequency distribution curve of auroral absorption for both hemispheres, normalized with respect to maximum values, is shown. The latitudinal frequency distribution of auroral absorption is identical in the Northern and Southern Hemispheres. Furthermore, the location of the zone, and of the maximum in particular, is symmetric in both hemispheres for the distribution obtained as a function of corrected geomagnetic latitudes. A map of the geographic distribution of anomalous absorption where isolines of 25%, 15%, and 10% frequency are plotted was constructed on the basis of data on latitudinal distribution P and from tables of corrected geomagnetic coordinates. Auroral absorption frequency was shown to increase with ΣK_p. The auroral absorption zone widened by ~8.5° at the auroral absorption frequency level of 10%. (BBB)

47991 INDIRECT EVIDENCE OF DAYTIME AURORA AT CONJUGATE POINTS. Hajkowicz, L. A. (Dept. of External Affairs, Melbourne). J. Atmos. Terrest. Phys., 30: 1649-55 (Sept. 1968).

The opposite solar illumination conditions at two geomagnetically conjugate points permit a study of the daytime cosmic-noise absorption events associated with visual auroral displays. The mean absorption ratio, derived from the related auroral absorption events for Macquarie Island–Kotzebue, varies throughout the year, reaching its minimum during the northern summer. The average time lag between the associated events is related to the mean absorption ratio. (auth) (UK)

47992 SOLAR FLARE EFFECTS AND SIMULTANEOUS MAGNETIC DAILY VARIATION, 1959–1961. Van Sabben, D. (Royal Netherlands Meteorological Inst., De Bilt). J. Atmos. Terrest. Phys., 30: 1641-8(Sept. 1968).

Representative ionospheric current systems of 5 s.f.e.'s of the years 1959 to 1961 are compared with the corresponding current systems of the magnetic daily variation at the times of these s.f.e.'s. (auth) (UK)

47993 ENERGETIC ELECTRON PRECIPITATION IN THE AURORAL ZONE AND ITS INFLUENCE ON ATOMIC OXYGEN IN THE MESOSPHERE. Brown, R. R. (Univ. of California, Berkeley). J. Atmos. Terrest. Phys., 30: 1723-8(Sept. 1968).

Calculations were carried out to evaluate the production rate of atomic oxygen in the mesosphere during auroral electron precipitation events involving electrons with energies in the range of hundreds of keV. Using current estimates of the electron flux and spectra, it is concluded that "relativistic electron precipitation" events serve to increase the oxygen concentration at 70 km in the pre-dawn hours, but not to the extent that its magnitude becomes comparable with those during daylight hours. (auth) (UK)

47994 AMPLITUDE AND PHASE SCINTILLATIONS OF WAVES SCATTERED FROM IONOSPHERIC IRREGULARITIES. Chytil, Bohumil (Geophysical Inst., Prague). J. Atmos. Terrest. Phys., 30: 1687-99(Sept. 1968).

The basic statistics of fluctuations of an electromagnetic wave after scattering from ionospheric irregularities are derived for the oblique incidence of a primary plane wave. The irregularities are assumed to be enclosed within a layer of finite thickness which is placed at a certain height above the ground. The spatial autocorrelation function of refractive index fluctuations is described by anisotropic Gauss and isotropic Bessel functions. The results obtained are compared with the conclusions of both diffraction and scattering theory so far achieved. (auth) (UK)

47995 F2-REGION EQUATORIAL ANOMALY DURING SOLSTICE PERIODS AT SUNSPOT MAXIMUM. Thomas, L. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1631-40(Sept. 1968).

The diurnal development of the F2-region equatorial anomaly was studied for the African, American, and East Asian sectors during quiet days about the June 1958 and December 1958 solstices. It was found that marked asymmetries in the daytime anomaly can occur, with the f_0F2 crest on the winter side larger than on the summer side, and h_mF2 at the winter crest about 100 km lower than at the summer crest. Such asymmetries are observed only in the American sector during the June solstice period, and in the African and East Asian sectors during the December solstice period. At these times the sub-solar point is far removed from the magnetic equator. The daytime anomaly in f_0F2 shows little or no asymmetry in the American sector during the December period or the African and East Asian sectors during the June period, but in each case h_mF2 at the winter crest is higher than at the summer crest. During the subsequent evening hours in these sectors a marked enhancement of the winter crest occurs and h_mF2 at the winter crest becomes lower than that at the summer crest. These results are briefly discussed in terms of ionization transport by neutral winds, differences in electron temperature, and other phenomena believed to contribute to the observed asymmetries. (auth) (UK)

47996 THE SEASONAL ANOMALY IN THE BEHAVIOUR OF THE F2-LAYER CRITICAL FREQUENCY. King, J. W.; Smith, P. A. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1707-13(Sept. 1968).

An analysis of several years' of monthly median noon critical-frequency data from more than 100 ground-based ionosondes has yielded a morphological picture of the ionosphere suggesting that the seasonal anomaly should be regarded in a new light. The number of months separating the observed biannual maxima of critical frequency is shown to vary markedly with the latitude of the observatory, and also through the solar cycle. The midwinter critical frequencies are greater than the summer values when the separation of the biannual maxima is least; this occurs in local winter at higher middle latitudes during sunspot-maximum conditions. (auth) (UK)

47997 A WORLDWIDE INVESTIGATION OF THE MID-LATITUDE EVENING INCREASE IN f_0F2 IN THE SUMMER HEMISPHERE. Papagiannis, M. D.; Mullaney, H. (Boston Univ.). J. Atmos. Terrest. Phys., 30: 1677-85(Sept. 1968).

Using the data and the computer program of the Ionospheric Prediction Services of ITSA–ESSA, six world contour maps of the evening anomaly were obtained in an effort to establish the geographic and local time characteristics of this phenomenon. The intensity of the anomaly is described by the index, $I(t) = 10\{[f_0F2(12.00) - f_0F2(t)]/f_0F2(12.00)\}$ which was plotted on world maps for t = 18.00, 21.00 and 24.00 hr local time for the months of June and December. The evening anomaly appears to be stronger in the northern hemisphere in June than in the southern hemisphere in December, and shows a tendency to peak in the areas where there is a spreading of the magnetic meridians along a given geographic latitude. It also shows signs of polar and conjugate point effects. (auth) (UK)

47998 WORLDWIDE DISTURBANCES IN THE F REGION ACCOMPANYING THE ONSET OF THE MAIN PHASE OF SEVERE MAGNETIC STORMS. Thomas, L. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1623-30(Sept. 1968).

A study was made of the detailed changes in N_mF2 occurring at several stations during the early stages of severe magnetic storms using, where available, quarter-hourly values of critical frequency. It was found that at the onset of the main phase of certain storms marked decreases in N_mF2 occur at a world-wide network of stations; during daytime the decreases have a duration of 2–3 hr, while during night-time the disturbances persist for many hours, especially at temperate latitudes. These reductions in N_mF2 are accompanied by increases in layer height. The observations are discussed in terms of current ideas on F2-region disturbances, and it is suggested that a redistribution of ionization caused by a vertical height-dependent motion represents a possible explanation. (auth) (UK)

47999 REMOVAL OF ERRORS FROM MONTHLY MEDIAN ABSORPTION CURVES. Hower, G. L.; Heisler, R. (Washington State Univ., Pullman). J. Atmos. Terrest. Phys., 30: 1719-22 (Sept. 1968).

Studies of the average levels of ionospheric absorption measured by a riometer are influenced by errors in the shape of the riometer quiet-day curve. A simple method is illustrated which provides corrections for such errors in cases where uncorrected absorption data are available. (auth) (UK)

48000 EFFECT OF A SOLAR ECLIPSE ON THE DEVELOPMENT OF THE IONOSPHERIC EQUATORIAL ANOMALY. King, J. W.; Eccles, D. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1715-18(Sept. 1968).

The development of the equatorial anomaly is shown to have been unaffected when the region of the Earth surrounding the magnetic equator at the appropriate longitude experienced an annular solar eclipse lasting for 3 hr, centred on 11.00 L.M.T. This result is significant because the equatorial ionosphere was eclipsed for an important part of the development phase (lasting from 07.00 to 15.00 L.M.T.) of the anomaly. (auth) (UK)

48001 BEHAVIOUR OF THE TOPSIDE IONOSPHERE AT MIDDLE LATITUDES AT NIGHT. King, J. W.; Rix, H. G.; Seabrook, C. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1605-13(Sept. 1968).

Data obtained by means of two different satellites and also from ground-based observatories were used to study the relationship

between the ionosphere at an altitude of 1000 km and at the peak of the F2 layer. Because of the change in ion composition and, hence, in electron scale height, which accompanies the cooling of the topside ionosphere at night, the diurnal variations of electron concentration at the two heights are quite different. The large maxima in the electron concentration at 1000 km, observed by Brace et al. (1967) near 40° geomagnetic latitude at night during 1965, appear to be less evident during years of higher sunspot number. It is suggested that the maxima may be associated with the relatively large decrease in electron temperature which occurs between day and night at 35°N and S geomagnetic latitude. (auth) (UK)

48002 A RESONANCE MODE TRACKER FOR THE ELECTROMAGNETIC EARTH-IONOSPHERE CAVITY. Nelson, Philip H. (Kennecott Copper Corp., Salt Lake City, Utah); Madden, Theodore R. IEEE (Inst. Elec. Electron. Eng.) Trans. Geosci. Electron., GE-6: 70-7(May 1968).

The theory of the effect of ionospheric perturbations on the Schumann resonances is discussed. It was predicted that changes in the ionosphere, such as the ionization increases which often occur following unusual solar flare activity, can produce measurable changes in the resonance properties. The prospect of using observations of the cavity resonances to examine worldwide ionosphere changes necessitated development of experimental equipment capable of continuously monitoring the resonance behavior. An analog tracking device was constructed which continuously monitors the peak frequency and Q of the first (8-Hz) resonance mode of the earth–ionosphere cavity. The device employs a phaselock technique to keep a tracking filter tuned to the center frequency of the natural spectral peak. Data from the resonance mode tracker illustrate the response of the cavity resonance to ionospheric disturbances, and to the source–receiver geometry. (BBB)

48003 OBLIQUE INCIDENCE OF STREAMS ON THE MAGNETOSPHERE. Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 19-22(1968).

Translated from Geomagn. Aeron., 8: 24-8(1968).

The space–time relationships upon oblique incidence of streams on the magnetosphere are analyzed. Formulas are obtained for the approximate computation of the delay of disturbances, the coordinates of the point of first contact between the front and the magnetosphere, and the time the magnetosphere is immersed in the stream. (auth)

48004 AURORAL HEIGHTS IN THE POLAR CAP. Starkov, G. V. (Polar Geophysical Inst., Kola Branch, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 28-32(1968).

Translated from Geomagn. Aeron., 8: 36-41(1968).

The vertical distribution of auroras at $\Phi' = 75°$ to 76° was obtained. Most of the auroras are located at heights of 145 to 180 km with a maximum at 150 and 175 km. Auroral height decreases as brightness increases. A relationship is obtained between the energy of injected particles and the K_p index for auroras at high latitudes. This relationship is found to be similar to the same relationship for Fritz's zone. The ratio of energies for these two sections of the auroral band is independent of the magnetic activity level. The average energy released on the day side is lower by approximately one order of magnitude than the corresponding energy on the night side of the instantaneous auroral zone. (auth)

48005 DIURNAL PATTERN OF AURORAL ABSORPTION IN THE AURORAL ZONE. Driatskii, V. M. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 33-8(1968).

Translated from Geomagn. Aeron., 8: 42-9(1968).

The diurnal pattern of auroral absorption is analyzed from data of the riometer network. A detailed comparison between auroral absorption and geomagnetic disturbance is made for one of the stations located in the auroral zone. It is concluded that the relationship between these two phenomena differs in character in the course of a day. Several assumptions are made regarding the nature of the phenomena in question. (auth)

48006 CHARACTERISTICS OF PROTON MOTION IN THE GEOMAGNETIC TRAP. Sarychev, V. T.; Troitskii, B. V. (Physical-Technical Inst., Kharkov). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 16-18(1968).

Translated from Geomagn. Aeron., 8: 20-3(1968).

The dynamics of charged particles in the geomagnetic trap were analyzed under conditions of the nonconservation of the first invariant of motion. It is shown that the latitudes of the mirror points are determined not only by the pitch angle, but also by the energy of a particle, the distance to the center of the dipole, and the angle characterizing the direction of the component of the velocity vector perpendicular to the magnetic field. An analytical expression is obtained, permitting determination of the latitude of a mirror point as a function of the initial data at the geomagnetic equator. (auth)

48007 COMPUTATION OF THE CORRELATION COEFFICIENT OF THE ENVELOPE AND THE WIDTH OF THE SPECTRUM OF A SIGNAL REFLECTED FROM THE IONOSPHERE. Vsekhsvyatskaya, I. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 39-44(1968).

Translated from Geomagn. Aeron., 8: 50-6(1968).

Closed expressions were obtained for the correlation function of the envelope, $\overline{RR}_\tau$, of a regular signal and of Poisson noise in the form of a single pulse $ae^{-\alpha t}$ and $a/\cosh \alpha t$ and with a distribution function $w(a) = 1/a_0 \exp(-a/a_0)$ in the neighborhood of the correlation maximum. These signals serve as models of the statistical properties of a wave reflected from the ionosphere. (auth)

48008 ELECTRON DENSITY IN THE LOWER IONOSPHERE IN PERIODS OF AURORAL ABSORPTION. Krupitskaya, T. M.; Khodzha-Akhmedov, Ch. L. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 45-8(1968).

Translated from Geomagn. Aeron., 8: 57-61(1968).

The vertical distributions of electron density and of absorption are computed. Use is made in the computations of the height dependence of electron collision frequency, obtained from rocket measurements. The computations are performed for various values of the index of frequency dependence in the range from 1 to 2. Riometer data at frequencies of 22.9, 32.0, 40, and 48.3 MHz are used to compare the computed with the experimental profiles obtained during auroral absorption. The values of the index of frequency dependence, n, are determined for individual absorption events. (auth)

48009 CONTRIBUTION TO THE THEORY OF THE SPORADIC-E LAYER. Gershman, B. N.; Grigor'ev, G. I.; Ignat'ev, Yu. A. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 57-61(1968).

Translated from Geomagn. Aeron., 8: 72-7(1968).

The instability that may appear during the formation of an E_S layer under the effect of a vertically inhomogeneous wind is analyzed. An instability criterion is obtained for the propagation of weak disturbances and estimates are given of the magnitude of possible increments. The fact that sporadic layers form during the passage of moving ionospheric disturbances is interpreted. (auth)

48010 INSTANTANEOUS ENERGY CHARACTERISTICS AND TRANSITION TO TIME-INTEGRAL ESTIMATES OF THE ENERGY OF GEOMAGNETIC STORMS. Zhulin, I. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 80-3(1968).

Translated from Geomagn. Aeron., 8: 102-6(1968).

The physical meaning of the instantaneous energy characteristics, E, of geomagnetic disturbances is analyzed. A simple physical explanation of the zero mutual energy of the main geomagnetic field H and the disturbance field ΔH is proposed. A new expression for E is obtained with allowance for the above equality and for the constant compression of the geomagnetosphere by the solar wind. The transition to the time-integral estimates of the energy of geomagnetic disturbances is being associated with the determination of the lifetime of charged particles in the magnetosphere, whose acceleration or increase in number determines the development of a storm. The integral energy of a medium storm over a time of the order of one day is $\sim 10^{24}$ erg. In this case, the intensity of a storm may reach 10^{19} to 10^{20} erg/sec. (auth)

48011 PROPAGATION OF GEOMAGNETIC DISTURBANCES IN AN UNEVENLY MAGNETIZED COLD PLASMA. Van'yan, L. L.; Dmitriev, V. I.; Belen'kaya, B. N. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 126-8(1968).

Translated from Geomagn. Aeron., 8: 159-61(1968).

For the propagation of a geomagnetic pulsation from a local source when an ideally conductive cold plasma oscillates across the external magnetic field with a frequency much lower than the gyrofrequency of ions, the problem of whether the directivity of the hydromagnetic emission is retained in a magnetic field with curvilinear lines of force is considered. (TSS)

48012 IONIZATION PRODUCED BY A SATELLITE IN THE UPPER ATMOSPHERE. Kovalevskii, A. F.; Nagorskii, P. M. (Physical-Technical Inst., Kharkov). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 137-8(1968).

Translated from Geomagn. Aeron., 8: 171(1968).

Calculations are made which show that the ionization produced in the upper atmosphere by a passing satellite is much less than has been previously reported. (J.H.R.)

48013 GEOMAGNETIC CONTROL OF VERTICAL IONIZATION DRIFT IN THE F REGION OF THE IONOSPHERE. Drobzhev, V. I. (Ionospheric Section, Alma-Alta, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 142(1968).

Translated from Geomagn. Aeron., 8: 176(1968).

The magnitudes and directions of the vertical ionization drift are computed, and results are compared with those determined from the method of spaced-frequency reception. (TSS)

48014 ALLOWANCE FOR THE DRIFT OF MOLECULAR IONS IN THE DETERMINATION OF THE KINETIC PARAMETERS OF IONIZATION–RECOMBINATION PROCESSES AT THE F2-LAYER MAXIMUM. Klimov, N. N.; Solov'ev, Yu. F. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 143 (1968).

Translated from Geomagn. Aeron., 8: 177(1968).

Previously, in determining the kinetic parameters of ionization–recombination processes, a term, allowing for vertical drift of molecular ions as a result of the motion of neutral air was added to the system of equations. It is shown in this note that this vertical drift can be neglected for years of high solar activity. (TSS)

48015 SOME CHARACTERISTICS OF VERTICAL DISPLACEMENTS OF IONIZED FORMATIONS. Vasil'ev, K. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 144-6 (1968).

Translated from Geomagn. Aeron., 8: 178-80(1968).

Data obtained during the IQSY at Tixie, Leningrad, Moscow, etc., were used to investigate the vertical movements of ionized masses. (TSS)

48016 DIRECTION AND DIMENSIONS OF VERTICALLY MOVING IONIZED FORMATIONS. Vinogradova, M. B.; Vasil'ev, K. N.; Bakanov, V. I. (Moscow State Univ. Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 146-8(1968).

Translated from Geomagn. Aeron., 8: 181-3(1968).

Observations were conducted at Krasnaya Pakhra, Moscow, and a temporary point to determine the speed and direction of moving ionized formations which have both vertical and horizontal velocity components. (TSS)

48017 IONOSPHERIC EFFECT OF THE SUDDEN COMMENCEMENT OF A MAGNETIC STORM IN YEARS OF MAXIMUM AND MINIMUM SOLAR ACTIVITY. Shashun'kina, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 149-51(1968).

Translated from Geomagn. Aeron., 8: 184-6(1968).

A specific ionospheric effect that differs during the daytime and at night is observed after the sudden commencement (SC) of the magnetic–ionospheric storms of July 15, 1959 (high solar activity) and June 15, 1965 (low solar activity) in the Northern Hemisphere. (TSS)

48018 SOME CORRELATIONS OF THE INTERVAL OF PULSATIONS OF DECREASING PERIOD ON FEBRUARY 12, 1964. Shchepetnov, P. V.; Kalisher, A. L. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 151-3 (1968).

Translated from Geomagn. Aeron., 8: 187-8(1968).

Some relationships between various geophysical effects accompanying pulsations of a decreasing period (PDP), observed during the moderate (K_p = 4) storm at 13–15 h VT on February 12, 1964, are described. (TSS)

48019 RELATIONSHIP BETWEEN PULSATIONS OF THE Pc1 TYPE AND MAGNETIC STORMS. Plyasova-Bakunina, T. A.; Matveeva, E. T. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 153-5(1968).

Translated from Geomagn. Aeron., 8: 189-90(1968).

Eight independent geomagnetic storms, observed against the background of the quietest magnetic field in years of minimum and increasing magnetic activity (1964–1966), were selected to study the relationship between the source of Pc1 pulsation and global magnetic storms. (TSS)

48020 RAPID VARIATIONS OF THE GEOMAGNETIC FIELD ACCORDING TO THE DATA OF ULAN BATOR OBSERVATORY. Dodon, G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 155-7(1968).

Translated from Geomagn. Aeron., 8: 191-2(1968).

A statistical analysis of three individual types of rapid variations (SPP baylike disturbances, and sudden commencements) in 1966 was performed on the basis of data from the geomagnetic observatory of Ulan Bator. (TSS)

48021 CYCLIC CHANGES IN S_q VARIATIONS. Pogrebnoi, V. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 157-9(1968).

Translated from Geomagn. Aeron., 8: 193(1968).

Observations of five 11-year solar activity cycles from the middle latitude station Rude Skov (55° 50′ N, 12° 27′ E) indicate that the dependence of the average annual amplitude of S_q(H) on R (within an interval from 0 to 80) is linear. Other properties of S_q variations are discussed. (TSS)

48022 CONTRIBUTION TO THE THEORY OF HYDROMAGNETIC WAVE INTERACTION WITH THE PROTONS OF THE GEOMAGNETIC TRAP. Kovalenko, V. S. (Physical-Technical Inst., Kharkov). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 11-15(1968).

Translated from Geomagn. Aeron., 8: 15-19(1968).

The interaction of protons of the geomagnetic trap with Alfvén waves was examined. A rigorous solution of a steady-state equation describing this process is presented. The relative number of particles with small pitch angles is estimated. (auth)

48023 SEASONAL CHANGES DISPLAYED BY F1-LAYER IONOGRAMS. Rishbeth, H.; Kervin, C. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1657-65(Sept. 1968).

Ionograms from three North American stations for the year 1958 were analyzed by an "overlay" method, similar to that of King and Lawden (1964). Marked seasonal changes were found in a parameter G which is related to photochemical rates; these changes are part of the F-region seasonal anomaly, and may be caused by changes in atmospheric composition or temperature. (auth) (UK)

48024 SEASONAL BEHAVIOUR OF THE TOPSIDE IONOSPHERE. King, J. W.; Hawkins, G. L.; Seabrook, C. (Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys., 30: 1701-6(Sept. 1968).

Alouette topside sounder data acquired over North America during the solstice periods of 1962 and 1963 indicate that, over a wide range of middle latitudes, the midday electron concentration values at various fixed heights (400, 600, 800 and 1000 km) are always substantially greater, by a factor of about two, at midsummer than at midwinter. This behavior is in complete contrast with that of the F2-layer critical frequencies observed at corresponding times and localities; the latter exhibit the usual seasonal anomaly in which the summer f_0F2 values are smaller than the winter values. (auth) (UK)

48025 MEASUREMENT OF THE LATITUDINAL PATTERN OF SCINTILLATIONS OF SATELLITE SIGNALS. Erukhimov, L. M.; Korobkov, Yu. S.; Maksimenko, O. I.; Mityakova, E. E.; Mityakov, N. A.; Rapoport, V. O.; Uraydov, V. N.; Cherepovetskii, V. A. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 138-40(1968).

Translated from Geomagn. Aeron., 8: 172-3(1968).

Observations on the amplitude and phase scintillations of signals from Explorer 22 were correlated for Murmansk, Gor'kii, and Ashkhabad (latitudes 64, 51, and 30°, respectively). Latitudinal patterns of the scintillation index of the level of satellite signals common to all three points are presented. (TSS)

48026 SYNCHROTRON RADIATION FROM ENERGETIC ELECTRONS IN THE MAGNETOSPHERE. Singh, R. N.; Singh, R. P. (Banaras Hindu Univ., India). Earth Planet. Sci. Lett., 4: 459-63(Aug. 1968).

It is shown that the total synchrotron radiated power varies along the lines of force. The total radiated power decreases for higher values of geocentric distance. Using experimental energetic electron density distribution along different lines of force it has been shown that the total synchrotron power is maximum at different latitude for different geomagnetic lines of force. It has also been shown that the position of the maximum synchrotron radiated power changes with the radiated frequencies. (M.O.W.)

48027 RELATIONSHIP BETWEEN GEOMAGNETIC ACTIVITY AND CHROMOSPHERIC Hα-FLARES. Oermenyi, I. (State Inst. of Rheumatism and Medical Hydrology, Budapest). Acta Geod., Geophys. Montanistica, 1: 121-36(1966). (In Hungarian).

Flare activity numbers are deduced from observations of chromospheric Hα flares in the following way. For every observed solar flare, the product of the brightness of Hα radiation for the

duration of the phenomenon possesses, as a rule, a different value. For a given day on which several solar flares are occurring, these products are added and then divided by the number of minutes in a day. The resulting values are published here for each day during the period of July 1, 1957 (i.e., the beginning of the International Geophysical Year) till Dec. 31, 1961. Having compared these values to the Magnetic Character Numbers of Göttingen, the author assumed that geomagnetic disturbances are probably caused mainly by chromospheric Hα flares, as they yield, for 1958–1961, an average value of the correlation coefficient r = +0.64, while by using smoothed curves one obtains r = +0.78. For the same period, the correlation coefficient between magnetic disturbances and Wolf's sunspot numbers has only the value of r = +0.07. (Meteorol. Geoastrophys. Abstr.)

48028 AURORAL ABSORPTION AT VOSTOK AND ITS RELATION TO MAGNETIC ACTIVITY. **Driatskii, V. M.; Zhigalov, L. N. (Arctic and Antarctic Scientific Research Inst., Vostok Station, Leningrad). Sov. Antarct. Exped. Inform. Bull., 6: 366-70(Mar. 1968).**

Auroral absorption events were studied at Vostok Station, located in the immediate vicinity of the geomagnetic pole. By agreement, Soviet and American antarctic expeditions made additional geophysical observations at this station in 1965 in a joint program which included recording cosmic noise intensity. The data obtained showed that auroral absorption can be observed under certain definite conditions in the vicinity of the geomagnetic pole. A riometer record with an absorption bay, made at Vostok Station from June 17–18, 1965, is illustrated. This bay commenced at ~23 hr 35 min. For comparison, riometer records from Mirny and Molodezhnaya, as well as the variations of the horizontal geomagnetic field component (H) are shown. Examination of all the riometer records made at Vostok Station in 1965 showed that absorption of this type is rare and is only observed in winter during the polar night. Most of these events were observed around local geomagnetic midnight. A table gives the characteristics of auroral absorption (A) and data on the state of the geomagnetic field. Each absorption event at Vostok Station coincided with the occurrence of absorption at other points. Large negative bays were observed at Vostok Station on days with a high ΣK_p index (>35) and, furthermore, the planetary disturbance in the 3-hr interval with a bay was also high ($K_p > 6$). This indicated that the magnetosphere was highly disturbed during the appearance of large negative bays at the geomagnetic pole at night. It is probably in these cases that conditions for the acceleration of the particles in the tail of the magnetosphere and for their penetration into the ionosphere of the polar region are created. Thus, a strong disturbance of the magnetosphere is a decisive factor in the appearance of negative magnetic bays and, probably, of auroral absorption at Vostok Station as well. (BBB)

48029 CONDITIONS UNDER WHICH NOCTILUCENT CLOUDS APPEAR IN THE MIRNY REGION. **Voskresenskii, A. I.; Tyatnenkov, B. A. (Arctic and Antarctic Research Inst., Vostok Station, Leningrad). Sov. Antarct. Exped. Inform. Bull., 6: 398-9 (May 1968).**

Noctilucent clouds were observed twice in the vicinity of Mirny Observatory on June 17, 1965, during the morning and evening nautical twilight. The appearance of the clouds coincided with considerable ionospheric–magnetic storm activity, which began on the 15th and ended on the 18th of June. Radar data for June 17 showed strong reflections between midnight and 03 hr 00 min and weak reflections between 20 hr 00 min and 22 hr 00 min. The ionosphere was strongly disturbed and sporadic layers were frequently observed. In the morning hours, complete absorption was observed, and in the evening weak reflections of the oblique type were recorded at heights of 140 to 170 km. Short-wave transmission was poor during this period. (BBB)

48030 NOCTILUCENT CLOUDS IN THE VICINITY OF MOLODEZHNAYA STATION. **Kreem, E. I. Sov. Antarct. Exped. Inform. Bull., 6: 399(May 1968).**

Noctilucent clouds were observed in the vicinity of this station on the night of October 13 from 01 hr 10 min to 02 hr 30 min Moscow time. Molodezhnaya Station, located on the coast of Antarctica, was in the area of a cyclone during the night from October 12 to 13. On the evening of October 12 the sky was covered with high clouds. At 22 hr 00 min the clouds began gradually to move away and at 00 hr 30 min on October 13 cloudiness had decreased to 3/10. At 20 hr 40 min on October 12 the south–southeasterly wind intensified to 18 m/sec and drifting snow began. The air temperature was −21°C. At this time an active aurora was observed. The appearance of noctilucent clouds at Mirny on June 17, 1965, also coincided with an aurora. (BBB)

48031 ON THE RELATION BETWEEN OPTICAL AND ELECTRICAL PROPERTIES OF IONOSPHERIC LAYERS. **Dietze, G.; Kohl, G. (Meteorologisches Observatorium Dresden-Wahnsdorf, Radebeul, Ger.). Z. Meteorol., 18: 212-18(1966). (In German).**

A relation between variation of sky light polarization at twilight and the critical frequencies of the E layer was found. Extensive data for simultaneous optical and electrical effects of high atmospheric dust of interplanetary origin were compared. Optical parameters for twilight and ionospheric parameters were compared; in particular, data for f_0E_1, fE_s, fbE_s, and E_s type from Lindau and f_0E, f_0E_s, and $h'E_s$ from Juliusruh were plotted against the depolarization sum and the polarization degree (P_{88}). No correlation was obtained, except for very weak correlations of f_0E_1 with P_{88}, f_0E with P_{88}, and f_0E_s with the depolarization sum. The last two correlation studies are illustrated. It is not clear why these studies do not support earlier correlative studies; perhaps unequal geographical and seasonal conditions affect the results, or possibly differences in the means of measurement. (BBB)

48032 ABNORMAL DIURNAL VARIATION OF TOTAL IONISATION. **Smith, D. H.; Nelson, G.; Pyke, J. R. (Univ. of Sydney). Nature (London), 219: 1144-5(Sept. 14, 1968).**

An ionospheric event is reported which apparently was not associated with a magnetic storm. At Moresby (9.4°S, 147.2°E) a "sudden commencement" was observed on November 27 at 0731 hr. (UT), but there was no evidence of even a moderate magnetic storm during this period. The abnormal behavior extended to the lower part of the F2 region. The diurnal behavior of the ionospheric parameters on November 28 and 29 differed from the "normal" behavior of November 27 and 30. It was not possible to give a satisfactory explanation in terms of any outstanding solar or geophysical occurrence. (UK)

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Refer also to abstracts 47267, 47413, 47439, 48199, and 48437.

48033 (LA-DC-9820) FLUX PUMP WORK AT LOS ALAMOS. **Laquer, H. L. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 13p. Dep. CFSTI.**

The developmental work on flux pumps from its initial stages to the present is outlined. (M.O.W.)

48034 (LA-tr-68-31) SUPERCONDUCTIVITY AND THE NATURE OF THE BOND IN CARBIDES AND NITRIDES OF TRANSITION METALS AND THEIR SOLID SOLUTIONS WITH NaCl-TYPE STRUCTURE. **Shulishova, O. I. Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from pp 299-316 of Khimicheskaya Svyaz v Poluprovodnikakh i Termodinamika, Institut Fiziki Tverdogo Tela i Popuprovodnikov Akademii Nauk Belorusskoi SSR, Izdatel'stvo Nauka i Tekhnika, 1966. 27p. Dep. CFSTI.**

It is shown that a change in superconducting transition temperature T_c is a sensitive indicator of the curve of density of states. A study was made of the T_c as a function of the valence electron concentration and homogeneity of the compounds and their solid solutions. Compounds studied included: TiC, NbC, ZrC, HfC, TaC, NbN, MoC, ZrN, WC. The results generally show a maximum of T_c at a valence electron concentration of 4.85 electrons/atom and a minimum at 4.2 electrons/atom. For solid solutions of isoelectronic compounds, T_c changes linearly with composition. The T_c–valence electron correlation is compared with the correlations for other properties; electric resistance, Hall effect, and magnetic susceptibility. The curve of the density of the states is compared with curves calculated from different bond models. The explanation of the homogeneity region is considered. (D.L.C.)

48035 (NP-17607) THEORY OF STABILIZATION OF A SUPERCONDUCTOR INTO THE RESISTIVE STATE. Research Report 290. **El Bindari, A. (Avco-Everett Research Lab., Everett, Mass.). July 1968. 20p.**

A theory of the stability of a superconductor carrying a transport current in the resistive mode is presented. The stability is dependent on a parameter θ such that if $\theta > 1$, the superconductor is unstable; if $\theta < 1$, the superconductor is stable. The recovery conditions from the resistive mode to the fully superconducting state are also studied. Under certain conditions, when the critical $I_c \propto d^n$, where d is the diameter of the superconductor and $n > 1$, the stability parameter θ is also a function of the dimensions of the superconductor. The influence of a normal metal in good electrical and thermal contact with the superconductor on the stability problem is also included. (auth)

48036 (NYO-3029-29) FLUX CREEP IN HARD SUPERCONDUCTORS. Report No. 921. **Beasley, Malcolm Roy (Cornell Univ., Ithaca, N. Y. Materials Science Center). June 1968. Contract AT(30-1)-3029. 139p. Dep. CFSTI.**

Thesis.

Flux creep in the critical state of some typical hard type-II superconductors was investigated in order to improve the basic understanding of the flux creep process and to assess the usefulness of flux creep measurements as a probe of the basic fluxoid pinning mechanisms. The measurements were made using a very sensitive magnetometer incorporating a superconducting quantum interference device as the flux sensing component. The details of this system are described, and its general usefulness and limitations are discussed. The observed flux changes showed the logarithmic time dependence characteristic of flux creep, and the creep rate $d\phi/d \log t$ was studied as a function of magnetic history, cold working, specimen size, and to some extent temperature. Departures from the critical state and creep in the superconducting sheath region above H_{c2} were also briefly investigated. Except at low fields, the detailed results were found to be in agreement with the behavior expected on the basis of the Anderson–Kim flux creep theory and to provide quantitative results for the material sensitive parameters of the theory (i.e., the pinning energy and the activation volume or flux bundle size). The measured pinning energies were found to be consistent with published estimates of the pinning properties of dislocations and indicate that each flux bundle interacts with many dislocations. (auth)

48037 (UCRL-18188) AN EXAMINATION OF A LIQUID HELIUM REFRIGERATION SYSTEM FOR SUPERCONDUCTING MAGNETS IN THE 200-GeV EXPERIMENTAL AREA. Green, Michael A.; Coombs, Gordon P.; Perry, James (California Univ., Berkeley. Lawrence Radiation Lab.). July 11, 1968. Contract W-7405-eng-48. 19p. (CONF-680621-4). Dep. CFSTI.

From Conference on Superconducting Devices and Accelerators, Upton, N. Y.

A summary is presented of a study of refrigeration of superconducting magnets in a 200-GeV accelerator. A model of the proposed 200-GeV experimental area is presented, and several 4.2°K helium refrigeration systems and their costs are analyzed. (D.L.C.)

48038 (UCRL-18374) ELECTRICAL LOSS MEASUREMENTS IN A NbTi MAGNET. Voelker, Ferd (California Univ., Berkeley. Lawrence Radiation Lab.). July 25, 1968. Contract W-7405-eng-48. 13p. Dep. CFSTI.

A superconducting solenoid wound with NbTi wire copper clad was used in developing an electrical method for measuring ac losses. The maximum field on axis is ~70 kG at 120 A. The method measures the accumulated electrical energy entering the magnet over a period of several cycles; the measuring circuit includes a multiplying circuit and an integrator for measuring the energy balance in the magnet. The variables studied include maximum current, hysteresis, eddy current losses, and flux jumps. (D.L.C.)

48039 SUPERCONDUCTING TRANSITION TEMPERATURES OF VARIOUS LEAD-BASE ALLOYS. Nembach, Eckhard (Univ. of California, Berkeley). Contract W-7405-eng-48. J. Phys. Chem. Solids, 29: 1205-11(July 1968). (UCRL-17905).

The superconducting transition temperatures T_c of lead-base alloys with 1 to 7 at.% Cd, Hg, In, Tl, Sn, Sb, and Bi were measured. T_c changed linearly with solute concentration. For the lighter solutes In, Sn, and Sb, T_c was higher than for the heavier elements of the same group of the periodic table. The reason for this seems to be a change in the phonon spectrum, caused by alloying. T_c was also measured for the system Pb–In in the range 0 to 65 at.% In. T_c decreased monotonically with increasing In content, in contrast to earlier findings for the system Pb–Tl. (auth) (UK)

48040 TUNNEL EFFECT BETWEEN TWO-ZONE SUPERCONDUCTORS WITH NONMAGNETIC IMPURITIES. Golub, A. A.; Moskalenko, V. A. (Inst. of Mathematics and Computer Center, Kishinev, USSR). Fiz. Metal. Metalloved., 25: 385-9 (1968). (In Russian).

While in single-zone superconductors with an isotropic energy gap nonmagnetic impurities do not affect the magnitude of the Josephson effect and the quasi-particle effect, in twin-zone superconductors containing such impurities the effects arising during tunneling are influenced by the concentration of impurities. In this connection a general formula of the current across the barrier for arbitrary voltage V(t) and at any temperature T is derived with the aid of a model two-zone hamiltonian and the method developed by A. I. Larkin and Yu. N. Ovchinnikov (Zh. Eksp. Teoret. Fiz., 51: 1535 (1966)) for the case of tunneling current between two identical twin-zone superconductors containing nonmagnetic impurities. It is demonstrated that the current indeed depends on the concentration of the nonmagnetic impurity in two limiting cases of high and low concentration. Further, it is pointed out that while the nonmagnetic impurity reduces the magnitude of the ordering parameters, it does not lead to gapless conductivity in twin-zone superconductors, even though it appreciably affects their energy spectrum, resulting in the formation of a single gap. (ATD)

48041 UPPER CRITICAL FIELD OF Zr–V ALLOYS. Yasohama, Kazuhiko; Usui, Nobumitsu (Tokyo Univ.). Jap. J. Appl. Phys., 7: 1128(Sept. 1968).

The upper critical field H_p and the superconducting transition temperature T_c were determined for the V–Zr system. Measurements of the resistive critical field H_r were made at 4.2°K on homogeneous alloy samples; H_r has its maximum value (~110 kG) near the composition 40 at. % V. The scattered T_c data indicated a maximum of ~8°K at ~60 at. % V. H_p was calculated from the H_r and T_c data. (D.L.C.)

48042 LIQUID STRUCTURE FACTOR OF GROUND-STATE ^{4}He. Mihara, N.; Puff, R. D. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Phys. Rev., 174: 221-7(Oct. 5, 1968). (RLO-1388-527).

A nonlinear integral equation for the liquid structure factor of ground-state ^{4}He, constructed from various frequency moments of the density–density correlation function, is proposed. This equation is solved for a particularly simple choice of two-body potential, and the results for the self-consistently-determined particle density are compared with experiment. The energy per particle and the sound velocity are also determined at the calculated density. The density, energy, and sound velocity, as well as the structure-factor curve as a function of k, all agree quite closely with experimental values. There are no free parameters once the choice of two-body potential has been made. (auth)

48043 MOBILITY OF NEGATIVE IONS ALONG VORTICES IN ROTATING SUPERFLUID HELIUM. Douglass, R. L. (American Univ. of Beirut). Phys. Rev., 174: 255-63(Oct. 5, 1968).

The mobility of negative ions trapped on linear vortices in rotating superfluid helium has been measured by a time-of-flight technique in the temperature range $0.8°K < T < 1.6°K$. Measurements could not be extended below 0.8°K because, contrary to the present theory, the ion escape rate became too large. No evidence of direct trapping of positive ions by vortex lines was observed down to 0.4°K. The trapped-ion mobility is interpreted in terms of scattering of the ion by thermal distributions of quantized vortex waves and rotons localized about the vortex axis. (auth)

48044 SUPERFLUID HELMHOLTZ RESONATORS. Kriss, M.; Rudnick, I. (Univ. of California, Los Angeles). Phys. Rev., 174: 326-9(Oct. 5, 1968).

It is shown that the master equation for a superfluid Helmholtz resonator is $\omega^2 = u_n^2 A/LV$, where ω is the angular-resonant frequency, u_n is alternately the velocity of first, second, and fourth sound, A is the cross-sectional area of the neck of length L, and V is the volume of the resonator. The fourth-sound resonance occurs when the resonator is packed with a porous medium that locks the normal fluid component. Experimental results on such a resonator are in agreement with this result. (auth)

48045 MAGNETIZATION IN SUPERCONDUCTING FILMS. Di Castro, C. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome); Tombesi, P.; Young, W. Nuovo Cim., 57B: 89-102(Sept. 11, 1968).

The magnetization as a function of the magnetic field has been studied for films of thickness l much less than the coherence distance ξ. The framework used is the pairing model with specular boundary conditions. For sufficiently low temperature and not-too-thin film the magnetization as a function of the magnetic field is shown to have a metastable branch corresponding to a similar branch in the order parameter Δ. A first-order phase transition is present in this case. At higher temperature or thinner films the magnetization is single valued and goes continuously to zero. A second-order phase transition occurs. The critical field behaves like $l^{-\frac{1}{3}}$ for very thin films ($l \lesssim a(\xi/k_F)^{\frac{1}{3}}$) and like $l^{-\frac{1}{2}}$ for thicker films ($l \gtrsim a(\xi/k_F)^{\frac{1}{2}}$), where a is a numerical factor. The weak field susceptibility in the first case has an l^3 dependence whereas there is a l^1 dependence in the second case. (auth)

48046 ON THE THEORY OF PROPAGATION OF TRANSVERSE SOUND IN SUPERCONDUCTORS. Belozorov, D. P.; Kaner, E. A. (Inst. of Radio Physics and Electronics, Kharkov). Zh. Eksp. Teor. Fiz., 55: 642-50(Aug. 1968). (In Russian).

It is shown that at low temperatures and comparatively high frequencies, the absorption and velocity dispersion of transverse sound in type-I superconductors are to a great extent determined by the macroscopic electromagnetic fields arising during propagation of the waves. (auth)

48047 NUCLEAR SPIN RELAXATION IN SMALL-SIZE SUPERCONDUCTORS. Melik-Barkhudarov, T. K. (Inst. of

Physics, Erevan). Zh. Eksp. Teor. Fiz., 55: 657-61(Aug. 1968). (In Russian).

The nuclear spin relaxation rate in superconductors with dimensions $l \ll \xi_0$ (where ξ_0 is the correlation parameter) is considered. It is shown that differences (as compared to the expression for a massive superconductor) appear only when spin–orbit interaction between the electrons and lattice inhomogeneities are taken into account. Despite its weakness, this interaction may significantly change the relaxation rate for small values of l; hence, the ratio of the relaxation rates for a superconductor and normal metal goes over to the usual expression for absorption of ultrasound waves. (auth)

48048 ON THE POSSIBILITY OF AN EXPERIMENTAL INVESTIGATION OF PERIODIC STRUCTURES IN SUPERCONDUCTORS OF THE SECOND KIND BY MEANS OF μ MESONS. Ivanter, I. G.; Smilga, V. P. Zh. Eksp. Teor. Fiz., 55: 548-51 (Aug. 1968). (In Russian).

It is proven that an analysis of the time course of μ-meson polarization in superconductors permits one to determine the nature of the periodic structure of the mixed state in superconductors of the second kind and also to verify the hypothesis regarding the existence of superconducting lines in superconductors of the third kind. (auth)

48049 ON THE ANOMALOUS PROPERTIES OF SUPERCONDUCTING COMPOUNDS OF THE V_3Si TYPE. Kats, E. I. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 584-8(Aug. 1968). (In Russian).

The behavior of compounds of the V_3Si type at low temperatures is considered on basis of the energy band model proposed by Weger (Rev. Mod. Phys., 36: 1(1964)). The effect of a magnetic field on the properties of the compounds is investigated. The results are in qualitative agreement with experimental data. (auth)

48050 ELECTRON INTERACTION IN SUPERCONDUCTORS WITH PARAMAGNETIC IMPURITIES. Ginzburg, S. L. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 55: 732-42(Aug. 1968). (In Russian).

The electron scattering amplitude in superconductors with paramagnetic impurities is determined. The effect of paramagnetic impurities on the superconducting transition temperature and on the gap at zero temperature is considered. It is shown that introduction of impurities results in an increase of the transition temperature and gap, providing the exchange part of the interaction is negative and the superconducting transition temperature is small compared with the characteristic Kondo temperature. (auth)

48051 ADSORPTION OF ATOMIC ADMIXTURES ON QUANTIZED VORTEXES IN LIQUID HELIUM II. Reut, L. S.; Fisher, I. Z. (Odessa State Univ.). Zh. Eksp. Teor. Fiz., 55: 722-31 (Aug. 1968). (In Russian).

It is shown that mixed quasi particles of a dilute ^3He solution in superfluid ^4He interact effectively with quantized vortexes, being attracted to them. An analysis of the interaction of an admixture quasi particle with a vortex line within the framework of the Landau superfluidity theory is presented. A general thermodynamic analysis of the behavior of the solution as a whole in the presence of a superfluid vortex line is also given. Admixture adsorption on vortexes is considerable at low temperatures, a consequence of this being the formation of a linear Fermi-fluid subsystem along the vortex axis. The limits of applicability of the thermodynamic approach to the problem of admixture adsorption on vortexes is discussed. (auth)

48052 TRANSPORT COEFFICIENTS OF A NORMAL FERMI LIQUID AT FINITE TEMPERATURES. Dy, K. S.; Pethick, C. J. (Univ. of Illinois, Urbana). Phys. Rev. Lett., 21: 876-8(Sept. 23, 1968).

Exact solutions of the quasi particle transport equation in the limit $T \to 0$ are used to calculate finite temperature corrections to the thermal conductivity and spin-diffusion coefficients of a normal Fermi liquid by a perturbation theory method. Application of the results to liquid ^3He yields an estimate for the Landau parameter F_1^s. (auth)

48053 A DESIGN CONSIDERATION OF SUPERCONDUCTING COILS FOR MHD GENERATORS. Koyama, Ken-ichi (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 469-76(Aug. 1968). (In Japanese).

The length of the stabilized superconducting wire and its cost are roughly estimated for one simple model of superconducting magnets. It is concluded that in this model the cost of the wire per electrical output of the generator is almost constant, independent of magnet parameters such as the magnetic field intensity, magnet length, etc. (NSA of Japan)

48054 DESTRUCTION OF SUPERCONDUCTIVITY BY A CURRENT. Baird, D. C. (Royal Military Coll., Kingston, Ont.); Mukherjee, B. K. Phys. Rev. Lett., 21: 996-8(Sept. 30, 1968).

A new model of the intermediate state in current-carrying superconductors is presented. The model predicts a resistance transition which is in reasonable agreement with experimental values. An introductory treatment of secondary effects is also given. (auth)

48055 TEMPERATURE OF CONVERSION INTO THE SUPERCONDUCTING STATE OF THE COMPOUND V_3Ga. Savitskii, E. M.; Baron, V. V.; Efimov, Yu. V. (Inst. of Metallurgy, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 316-19(1968). (In Russian).

The influence of chemical composition, crystalline structure, and conditions of alloy production on the superconducting conversion temperature of V_3Ga were examined. Conversion temperature was determined by measurement of the magnetic permeability of samples at temperatures higher than 4.2°K. The value of the critical temperature was determined by the average point of conversion of the sample from the superconducting to normal state. It was found that only the beta-phase low temperature modification of V_3Ga (Cr_3Si-type structure) has superconductivity at temperatures higher than 4.2°K, but it is possible that the beta'-phase V_3Ga (CsCl-type structure), formed at temperatures above 1155°C, has a critical temperature lower than 4.2°K. Cast alloys have a comparatively low critical temperature (up to 13°K), and a broad conversion temperature interval (reaching 3 to 5°K). The highest conversion temperatures were observed in alloys hardened after homogenization at 1150°C. The critical temperature of the beta-phase increases with increased equilibrium of alloys and increase of degree of ordering in the crystalline structure, but the temperature interval of conversion from superconducting to normal state decreases. The maximum critical temperature of the beta-phase is observed at 26 at. % Ga (15.8°K in a sample with impurities less than 0.1% by weight). Impurities have a great influence on the value of the critical temperature of beta-phase V_3Ga. (ATD)

48056 COUPLED MOTION OF VORTICES IN SUPERPOSED SUPERCONDUCTING FILMS. Deltour, R.; Tinkham, M. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 174: 478-81(Oct. 10, 1968).

The coupling of vortices between two superconducting tin films electrically insulated from one another (i.e., in a dc transformer) has been studied as a function of the applied perpendicular magnetic field, of the current in the primary, and of the temperature. The results are qualitatively interpreted in terms of a vortex-slipping mechanism, and they support the picture of vortex flow as the dissipation process in superconducting films. (auth)

48057 SUPERCONDUCTIVE TRANSITION TEMPERATURES OF REACTIVELY SPUTTERED NIOBIUM FILMS. Mitszuoka, Takeshi; Yamashita, Tsutomu; Nakazawa, Tokuro; Onodera, Yutaka; Saito, Yukinori; Anayama, Takeshi (Tohoku Univ., Sendai). J. Appl. Phys., 39: 4788-91(Sept. 1968).

Niobium films have been examined with respect to their electrical and superconductive properties. The films were deposited by dc and asymmetric ac sputtering techniques in argon with addition of a small amount of nitrogen gas. The films obtained had a wide range of resistivities and transition temperatures depending on the partial nitrogen pressure in the argon atmosphere. The maximum transition temperature of films obtained was 15.3°K, which is very close to those reported for bulk NbN. It was found that the asymmetric ac sputtering technique is useful to increase the transition temperature of niobium films sputtered reactively in the presence of a nitrogen gas. (auth)

48058 RELATIONSHIP BETWEEN THE CRITICAL TEMPERATURE AND NORMAL-STATE MAGNETIC PROPERTIES OF A SUPERCONDUCTOR CONTAINING MAGNETIC IMPURITIES. Toxen, A. M.; Kwok, P. C.; Gambino, R. J. (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev. Lett., 21: 792-4(Sept. 16, 1968).

Measurements of the superconducting critical temperature and normal-state magnetization were carried out on a series of samples of $LaSn_3$ with up to 12.3 at. % of the lanthanum replaced by gadolinium. The observed variation of critical temperature with Gd concentration follows the Abrikosov–Gorkov relation for the more dilute samples, but at higher Gd concentration deviations are observed which are qualitatively similar to those observed for La–Gd alloys. These results, experimental and theoretical, strongly suggest that spin–spin correlations, even in the absence of magnetic ordering, are important in determining the properties of superconductors containing magnetic impurities. (M.O.W.)

48059 SUPERCONDUCTIVITY OF SOME SOLID SOLUTIONS BETWEEN COMPOUNDS OF A15 STRUCTURE ON NIOBIUM BASE. Otto, G. (Univ., Giessen, Ger.). Z. Phys., 215: 323-34(1968). (In German).

Solid solutions between the compounds Nb_3Al, Nb_3Ga, Nb_3Ge, Nb_3In, and Nb_3Sn have been prepared by arc melting in argon atmosphere. Transitions to superconductivity, lattice constants, and values of microhardness have been measured for all samples as-cast as well as annealed. In agreement with Matthias et al., the highest transition to superconductivity at 20.05°K has been observed in the system $Nb_3(Al_{1-x}Ge_x)$. A relation between microhardness and transition to superconductivity also expressed by Matthias has been verified for most of the systems. (auth)

48060 POSSIBILITY OF PHOTOINDUCED SUPERCONDUCTIVITY. Kumar, N.; Sinha, K. P. (National Chemical Lab., Poona). Phys. Rev., 174: 482-8(Oct. 10, 1968).

The possibility of interband electron pairing induced by the virtual exchange of quanta of two boson fields (photons and phonons) is theoretically examined. The system in question comprises two conduction bands which are, in general, separated by an energy gap E_{bc}. Radiative transitions between states of these bands are assumed to be allowed. Through appropriate canonical transformations, effective interband electron-electron interaction terms are obtained which involve, respectively, virtual exchange of (i) one photon (one-boson process), and (ii) one photon and one phonon (two-boson process). These are found to be attractive under certain conditions. The one-photon process is, however, rendered inconsequential owing to the very small volume of momentum space spanned by "interaction quantum" (photon) exchanged. The two-boson process, on the other hand, does not suffer from the above momentum-space restriction. Moreover, this latter process contains terms linear in the photon and the phonon occupation-number densities, and the reduction in the matrix elements can be compensated by boosting the boson occupation-number densities artificially. Estimates show that the photon-occupation-number term will be significant for a value of $n_{\lambda 0}/V \sim 10^{16}/cm^3$, where $n_{\lambda 0}$ is the photon occupation number and V is the volume. The corresponding phonon occupation-number density has to be of the order of $10^{20}/cm^3$. In that case, the interaction term is found to be anisotropic with respect to the direction of injected phonons. Expressions for the superconducting energy gaps at T = 0°K are derived by a Green's-function technique. The transition temperature for $n_{\lambda 0}/V \sim 10^{17}/cm^3$ is found to be of the order of 10^2 °K. (auth)

48061 HARD-SPHERE BOSE GAS MODEL FOR SUPERFLUID HELIUM. Singh, A. D. (Univ. of Waterloo, Ont.). Can. J. Phys., 46: 1801-8(Aug. 15, 1968).

The density dependence of the properties of a dense hard-sphere Bose gas are calculated. The double-time, retarded Green functions and the t-matrix approach are used to derive the energy spectrum of the elementary excitations. This energy spectrum is then used to calculate the various macroscopic properties of the system. The usefulness of the hard-sphere Bose gas model for understanding the pressure dependence of the properties of superfluid helium is brought out. (auth)

48062 FLUX JUMPS IN NIOBIUM–ZIRCONIUM ALLOY CYLINDERS AT LIQUID HELIUM TEMPERATURES. Morton, N. (Univ. of Salford, Eng.). Cryogenics, 8: 209-14(Aug. 1968).

The appropriate thermal diffusivity equations for cylindrical samples of hard superconductors immersed in liquid helium during magnetization are solved to find the temperature distributions in a variety of situations. Significant temperature differences within the mixed-state region are assumed to initiate flux jumps, thus allowing estimation of the magnetic field at which a flux jump is expected. The experimental systematics of flux jumps are compared with the theory. (auth) (UK)

48063 PHASE TRANSFORMATIONS IN SUPERCONDUCTING Ti–Nb ALLOYS. Hatt, B. A.; Rivlin, V. G. (Fulmer Research Inst., Ltd., Stoke Poges, Eng.). J. Phys., D (London), 1: 1145-9 (Sept. 1968).

Single-crystal x-ray results are given for specimens of Ti–20.7 at. % Nb. These enable their known current-carrying capacity in the superconducting state to be interpreted in terms of the response of phase structure to metallurgical treatment, and especially in terms of the transformation products obtained by quenching from the β phase (body-centered cubic) and subsequent ageing. Strain from heavy cold-work is shown to favor the precipitation of particles of the equilibrium hexagonal phase, α-Ti, on subsequent ageing. The α-Ti precipitate is believed to contribute to flux pinning. Quenching form the β phase causes transformation to α'', an orthorhombic metastable phase, which can maintain high currents. Ageing at low temperatures for short times causes reversion of α'' to β with a fall in current-carrying capacity. Further ageing brings about the $\beta \rightarrow \omega$ transformation, where ω is a hexagonal metastable phase, and the appearance of ω can be correlated with a recovery of current-carrying capacity. A new metastable phase, with a tetragonal structure, is reported for Ti – 25 at. % Nb in the as-worked condition. (auth) (UK)

48064 ELECTRON DRAG AND FLOW STRESS IN NIOBIUM AND LEAD AT 4.2°K. Kojima, H.; Suzuki, T. (Tokyo Univ.). Phys. Rev. Lett., 21: 896-8(Sept. 23, 1968).

It has been found that the flow stresses of superconducting niobium and lead at 4.2°K increase in the transition between superconducting and normal states produced by an external magnetic field. The ratio of the increment to the flow stress in the superconducting state is 2.9% in lead and 0.6% in niobium. It is concluded that the conduction electrons in the normal metals are impeditive for the motion of dislocations. (auth)

48065 METAL CRYOSTATS FOR SUPERCONDUCTING SOLENOIDS. Endig, M.; Lange, F. (Forschungsgemeinschaft, Dresden). Cryogenics, 8: 215-20(Aug. 1968).

The cryostat described is characterized by the fact that the outer dewar vessel has no additional containers to be filled with cooling liquids (N_2, Ne, H_2). The required cooling of the radiation screens is effected by means of narrow gaps filled with the evaporating helium gas either from vessels filled with cooling liquids or from heat exchangers utilizing the enthalpy of the evaporated helium. The acceptable heat transfer between the current leads and the cooling vessels or the heat exchangers, respectively, is ensured by newly developed electrically insulating heat contacts. Details of the quantities of cooling liquids required for the operation of the cryostat with a superconducting solenoid are given. The durations necessary for cooling down the solenoid in several cooling baths, as well as subsequent to a quench of the superconducting solenoid, are specified. (auth) (UK)

48066 HIGH CURRENT DENSITY 9 kJ SUPERCONDUCTING MAGNET WITHOUT DEGRADATION. Montgomery, D. B. (Massachusetts Inst. of Tech., Cambridge); Rinderer, L. Cryogenics, 8: 221-4(Aug. 1968).

A co-drawn niobium–titanium copper composite conductor was used to construct a 36-mm-clear inner-diameter magnet generating 72.5 kOe at 36 A. The overall winding current density at 36 A is 1.85×10^4 A/cm^2. Individual sections of the winding achieve a current density of 2.85×10^4 and 2.5×10^4 A/cm^2 at 52.5 kOe. Performance, construction, and a design criterion for the proper choice of copper to superconducting ratio are discussed. (auth) (UK)

48067 SUPERCONDUCTING STRIP DELAY LINE. Glebovich, G. V. (Gorky Polytechnic Inst., USSR). Cryogenics, 8: 235-7 (Aug. 1968).

A superconducting strip delay line is described having a pass band of 35.2 GHz for a delay of 50 nsec, and a wide band junction with a coaxial cable. Experimental results are given. (auth) (UK)

48068 OPTIMUM FLOW CONDITIONS FOR LIQUID COOLANTS IN SUPERCONDUCTING POWER CABLES. Swift, D. A. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics, 8: 238-43(Aug. 1968).

The cost of the helium refrigerator and coolant will form a substantial part of the overall price of a superconducting power cable. This cost is minimized by having coolant circuits, refrigerator spacings, and duct designs which allow the installation of large plant and the efficient use of the helium. The relationships required to achieve these conditions were theoretically determined and used to analyze a possible cable design. The theory was also extended to establish the cheapest stand-by-plant arrangement and the cost penalty involved when wayleave difficulties necessitate the nonoptimum siting of cooling stations. (auth) (UK)

48069 CONCERNING THE REDUCTION OF LIQUID HELIUM CONSUMPTION IN SUPERCONDUCTING MAGNETIC OPERATION. Montgomery, D. B.; Iwasa, Y. (Massachusetts Inst. of Tech., Cambridge). Cryogenics, 8: 247-8(Aug. 1968).

A superconducting magnet, in a typical situation, is used frequently but not continuously. Generally, therefore, it may be either recooled for each use or kept at helium temperature for extended periods, depending on whether the standby losses at 4.2°K are less or greater than the helium required to recool from 77°K. This note suggests an intermediate solution—that the magnet be held at a temperature between 4.2° and 77°K when not in use. The helium required to recool the magnet diminishes rapidly as the holding temperature is reduced, and if an economical way of holding intermediate temperatures is employed, a considerable saving in helium can be achieved. (UK)

48070 PHONON-LIMITED DRIFT OF THE ELECTRON BUBBLE IN SUPERFLUID HELIUM. Schwarz, K. W.; Stark, R. W. (Univ. of Chicago). Phys. Rev. Lett., 21: 967-9(Sept. 30, 1968).

Measurements were made of the negative ion mobility in He II for $T \leq 0.5°K$. It is shown that the usual kinetic-theory approach to ion drift in He II is inadequate, and a more realistic model is described. It is found that inelastic phonon scattering is the dominant process determining the mobility of the electron bubble at these temperatures. (auth)

48071 THEORY OF NUCLEATION RATES. Langer, J. S. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev. Lett., 21: 973-6(Sept. 30, 1968).

A general procedure is outlined for the first-principles calculation of the rate of decay of a metastable phase. (auth)

48072 ELECTRODYNAMICS OF SUPERCONDUCTORS WITH P PAIRING AND THE COLLECTIVE EXCITATIONS. Czerwonko, J. (Univ. of Wroclaw). Acta Phys. Pol., 34: 11-24(July 1968).

The transverse part of the polarization operator for a superconductor with P pairing and with an isotropic energy gap is calculated. The result gives the surface impedance of a superconducting metal and is applied to the problem of absorption peaks within the energy gap in mercury. There is an interesting difference between the obtained results and the results for a system with S pairing. The method applied is that of a superconducting Fermi liquid. (auth)

48073 MODELS OF A SUPERCONDUCTOR WITH ANISOTROPIC ENERGY GAP. Paszkiewicz, T.; Tekiel, P. (Univ. of Wroclaw). Acta Phys. Pol., 34: 3-10(July 1968).

For the anisotropic mixture of the p- and s-relative wave pairs the solution of the gap equations are obtained. Such system has, at the absolute zero temperature, the nonvanishing static spin susceptibility. (auth)

Plasma and Thermonuclear Physics

48074 (AED-C-03-21) PLASMA PHYSICS INDEX. EXPERIMENTAL AND THEORETICAL PLASMA PHYSICS. Bibliography; Author Index; Subject Index. Volume 3, No. 6. Hilsenbeck, D. (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 232p. Dep.

Four-hundred and sixty-four articles on various aspects of plasma physics are listed. Subject and author indexes are included. (M.O.W.)

Confinement and Heating of Plasma

Refer also to abstracts 47438 and 47440.

48075 (NP-tr-1668) ABSORPTION OF MICROWAVE POWER BY A PLASMA AT FREQUENCIES BELOW THE ELECTRON CYCLOTRON FREQUENCY. Budnikov, V. N.; Golant, V. E.; Obukhov, A. A. (Akademiya Nauk SSSR, Leningrad, Fiziko-Tekhnicheskii Institut). Translated for Culham Lab., Abingdon, Eng., from pp 1-19 of Preprint No. 068. 9p. (CTO-494). Dep. CFSTI. UK.

An experimental measurement was made of the absorption of microwave power in a magnetic field significantly exceeding the cyclotron field. Measurements of the attenuation of the transmitted signal are given as a function of the mean density. (M.O.W.)

48076 (MATT-Trans-57) DAMPING OF A SUPERHIGH-FREQUENCY FIELD IN A PLASMA IN THE PRESENCE OF MAGNETIC FIELDS APPRECIABLY GREATER THAN THE CYCLOTRON FIELD. Budnikov, V. N.; Golant, V. E.; Obukhov, A. A. (Akademiya Nauk SSSR, Leningrad, Fiziko-Tekhnicheskii Institut). Translated for Plasma Physics Lab., Princeton Univ., N. J., from a Russian report. 13p. Dep. CFSTI.

Experiments demonstrated the possibility of effective absorption of superhigh-frequency energy by a plasma in a magnetic field appreciably exceeding the cyclotron field under the conditions of weak influence of collisions. (M.O.W.)

48077 (MATT-Trans-60) CYCLOTRON HEATING OF PLASMA IONS AND ELECTRONS BY HIGH-FREQUENCY FIELDS. Galaktionov, B. V.; Novik, K. M.; Podushnikova, K. A.; Poloskin, B. P.; Shcherbinin, O. N. (Akademiya Nauk SSSR, Leningrad, Fiziko-Tekhnicheskii Institut). Translated for Plasma Physics Lab., Princeton Univ., N. J., from a Russian report. 16p. Dep. CFSTI.

In this experiment the possibility of creating a plasma with independently regulated energy of the plasma electrons and ions was investigated. Superhigh-frequency power was used to heat the electrons. The technique for exciting an ionic cyclotron wave proposed by Stix was used to heat the ions. (M.O.W.)

48078 CERTAIN FEATURES OF THE BEHAVIOR OF A ROTATING PLASMA IN A TRAP WITH MAGNETIC STOPPERS. Volosov, V. I.; Pal'chikov, V. E.; Tsel'nik, F. A. Dokl. Akad. Nauk SSSR, 181: 575-6(July 21, 1968). (In Russian).

The ion distribution anisotropy in velocity space, which is unavoidable in a trap with magnetic stoppers, leads to the development of an instability. The introduction of a radial electric field E decreases the anisotropy. Actually the adiabatic invariant in the presence of a slowly varying radial electric field E is the term: $\mu^* = r_0^2\,\omega_H\,(1+\alpha^2)^{0.5}$. Here $\alpha^2 = 4eE/m\omega_H\,r_0^2$; ω_H is the Larmor frequency; r_0 is the initial radius of the particle. The magnetic field has axial symmetry. On combining this equation with expressions for the conservation of energy and angular momentum, it is easy to obtain an equation for the limit of particle retention in velocity space. The particle retention region is bounded by a hyperbola having an axis displaced by an amount equal to the particle drift velocity. Thus a magnetic mirror machine with a radial electric field is an ideal trap for retaining a charged particle whose initial kinetic energy is below a certain threshold value. It is shown that the presence of a radial electric field E leads to stabilization of the instability associated with the ion distribution anisotropy. (TTT)

48079 STEADY FLOW OF CHARGED PARTICLES ACROSS A MAGNETIC FIELD. Miyajima, Shigeki (Nagoya Univ., Japan). Kakuyugo-Kenkyu, 21: No. 1, 13-31(June 1968). (In Japanese).

With the object of studying steady flow of charged particles across a magnetic field, the Langmuir probe curve in a transverse magnetic field is discussed. The hydrodynamic flow of charged particles in the magnetic field is analogous to expansion of a gas through a Laval nozzle and is complicated by the electron critical point and the ion critical point of the Bernoulli equations. Under some conditions, however, only the ion critical point is present for the flow in which ions are in excess and only the electron critical point is present for the flow in which electrons are in excess. When the transverse magnetic field is increased, the Langmuir probe curve theoretically shifts toward the low voltage. Furthermore, when the magnetic field exceeds a certain value solution of steady flow is not present due to losses of charged particles to present the probe. (NSA of Japan)

48080 TURBULENT HEATING OF PLASMA IN ANNIHILATION OF OPPOSING MAGNETIC FIELDS. Babykin, M. V. Zh. Tekh. Fiz., 38: 603-10(Apr. 1968). (In Russian).

This is a review article in which the author analyzes the conditions under which turbulent heating of a plasma is possible in the current layer separating the plasma-compressing magnetic field from the oppositely directed magnetic field that is introduced into the plasma to improve the heating. It is shown that for turbulence to develop it is necessary that the current velocity of electrons exceed a certain critical value, thus limiting the number of particles in the current layer at a given magnetic field differential. The experimental conditions that must be satisfied in order to realize turbulent plasma heating by opposing fields are discussed and it is shown that to avoid appreciable losses of the opposing magnetic flux it is necessary that the buildup time of the external field be smaller than the characteristic lifetime of the frozen-in field. Turbulent heating between opposing fields is compared with heating by collision of free-shock waves and it is noted that, at equal magnetic-field growth rates, it is possible to use larger alternating field amplitudes in the opposing-field method and thus obtain a larger pressure of the heated plasma. Methods of most effective utilization of the diffusion of the opposing magnetic fields for plasma heating are discussed. (ATD)

48081 FREE EXPANSION OF AN ISOLATED PLASMA COLUMN. Hyman, Julius Jr. (Univ. of California, Los Angeles). J. Appl. Phys., 39: 4568-73(Sept. 1968).

An isolated column of plasma is formed by the partial ionization of neutral argon gas with an intense, high-energy photon beam. The manner in which this plasma expands radially from its initial prescribed position is observed in a region where the plasma has no interaction with confining walls. It is shown that the expansion proceeds initially in accord with the wave equation, having a velocity of propagation $u \approx (\gamma k T_e/M_i)^{\frac{1}{2}}$, a value predicted theoretically by Shimony and Cahn. The driving force for the plasma expansion comes from the electrons, which are in turn cooled predominately by the adiabatic expansion. (auth)

48082 TURBULENT PLASMA HEATING IN A TORUS. Fanchenko, S. D.; Demidov, B. A.; Elagin, N. I.; Perepelkin, N. F. (Kurtchatov Inst. of Atomic Energy, Moscow). Phys. Rev. Lett., 21: 789-91(Sept. 16, 1968).

Turbulent heating has been applied to plasmas of density 10^{11} to 5×10^{13} cm^{-3} in a bumpy torus for the purpose of observing afterglow confinement. An rf electric field of up to 250 V/cm ringing at 1 Mc/sec was induced parallel to the axis for 1 μsec. The plasma was observed to remain in confinement for several microseconds after current cutoff, the initial nT being as high as (5 to 7) $\times 10^{15}$ eV cm^{-3}. (auth)

Diagnostics of Plasma

Refer also to abstract 47418.

48083 (JUL-537-PP) RAPID TIME- AND SPACE RESOLVED MEASUREMENT OF LUMINOUS DENSITY DISTRIBUTIONS. Hopmann, W. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). June 1968. 12p. Dep.

The measurement of luminous density distribution in plasmas by densitometric evaluation of pictures, taken with high-speed image-converter or rotating-mirror cameras, suffers from the uncertainties in spectral response, sensitivity, and the reciprocity-law failure of photographic emulsions. The time elapsed by film processing can often be troublesome. On the other hand, arrangements with multiple light pipes and photomultipliers give a good time but a poor space resolution; moreover, several oscilloscopes must be used. The video output signal of a shuttered TV-camera System yields the luminous density distribution on the photocathode of the camera tube. Using a special line selector switch, up to 10 selected lines of a single exposure were measured with one oscilloscope. The encouraging results of this technique, applied to several experiments in the Institute, have led to the design of a new compact and versatile system. It consists of the TV camera, the shutter pulse generator, and the recording unit. The latter comprises the multiple-line oscilloscope and a cinescope with a flat-faced picture tube of excellent geometry for recording purposes. The incorporation of an electronic isophote converter is envisaged. By use of image orthicon camera tubes with bialcali photocathodes a shutter efficiency of 10^5 was achieved, the sensitivity is 45 DIN (~16,000 ASA). The transfer function is linear within a contrast range of 1:25, and the accuracy (5 to 10%) is limited by the beam noise in the tube. (auth)

48084 ELECTRON AND ION DISTRIBUTIONS IN HOMOGENEOUS PLASMA. Crisan, M. (Inst. of Physics, Cluj). Stud. Cercet. Fiz., 20: 1-6(1968). (In Rumanian).

Two expressions for fermion and boson distributions are obtained in a form resembling the usual one. This time, the Fermi level depends however on η_p, η_q, and V_{Pq} quantities. The standard formulas for the respective distributions are rederived as a limiting case when the interaction between particles is neglected. (auth)

48085 DENSITY MEASUREMENT OF PLASMA BY CO_2 LASER INTERFEROMETER. Miyamoto, Kenro (Nagoya Univ., Japan); Kon, Shozo; Morimoto, Shigeyuki; Yamamoto, Junya; Yoshinaga, Hiroshi. Jap. J. Appl. Phys., 7: 1304(Oct. 1968).

A method of using CO_2 laser interferometer (wavelength λ = 10.6 μ) is described for the density measurement of plasma in intermediate region of 10^{14} ~10^{16} cm^{-3}. This interferometer is used for the density measurement of a plasma of BSG device. (M.O.W.)

48086 PLASMA-DENSITY DETERMINATION FROM THE PHASE SHIFT IN SCATTERED RADIATION. Jones, A. R.; Stanic, B. V.; Wooding, E. R. (Univ. of London). Electron. Lett., 4: 392-3(Sept. 1968).

Electron densities in a plasma column may be estimated from measurements of phase shift in the radiation scattered at various angles. (auth) (UK)

48087 DIAGNOSTICS OF A DEUTERIUM PLASMA ION COMPONENT BY MEANS OF THE DIFFERENTIAL NEUTRON SPECTRUM. Bogdanov, S. P.; Volosov, V. I. Zh. Tekh. Fiz., 38: 618-23(Apr. 1968). (In Russian).

The differential neutron spectrum of the deuterium plasma as a function of the energy of its ion component is analyzed. The treatment follows that of Faust and Harris and establishes the dependence of the neutron spectrum width and the mean energy of the deuterium ions as well as the effect of their distribution function on the character of that dependence. In the case of isotropic Maxwellian distribution of ion velocities, the half-amplitude width of the neutron spectrum determines the effective ion energy which in this case coincides with their mean energy. In monoenergetic plasma, the neutron spectrum differs but retains a definite relationship with the effective ion energy. Formulas are obtained to describe the relationships. An attempt is made to obtain a generalized formula which would be applicable for any distribution function. This formula, however, in its simplest form somewhat understates the effective ion energy values in the case of Maxwellian distribution. The result can be corrected by accounting for additional terms of the series expansion. (ATD)

48088 DEUTERIUM PLASMA TEMPERATURE MEASUREMENT BY ITS EFFLUX VELOCITY. Goncharova, G. I.; Aleksandrova, A. G. Zh. Tekh. Fiz., 38: 624-7(Apr. 1968). (In Russian).

An experimental study was made and the necessary setup developed for measurement of plasma temperatures on the basis of the velocity of the escape front of the gas into a rarefied medium. The setup consisted of a chamber formed by two cylindrical electrodes and filled with deuterium at pressures up to 150 to 300 mm Hg and connected through a membrane to a measuring tube equipped with a photomultiplier for recording the shock wave velocity beyond the membrane. The plasma was generated by a high-power pulse discharge within the chamber. The basic theoretical relationships between the escape velocity of the deuterium and its density and temperature were derived from Zel'dovich and Raizer. A set of curves was calculated from these relationships depicting the dependence of the efflux front velocity on the initial density and temperature. The experimental parameters of deuterium plasma measured at the instant of maximum brightness of the continuum differ somewhat from parameters obtained from the efflux velocity; this difference is thought to be due to a radial temperature profile in the chamber and to a certain deviation from strict plane of the rarefaction wave front. The method is considered useful for measurement of single plasma pulses. (ATD)

48089 ANALYSIS OF THE ERROR OF MICROWAVE INTERFEROMETRY OF THE PLASMA ON SEVERAL PATHS. Anicin, B. A. Bull. Boris Kidric Inst. Nucl. Sci., Phys., 19: No. 2, 7-12(May 1968).

The error of microwave interferometry of the plasma on several paths, which results from the difference between the refracted and rectilinear phase path and the effect of the phase change of the received signal induced by the change of position of the microwave beam on the reception aerial, has been estimated. For parabolic distribution of electron concentration the largest error is equal to a double maximum to critical electron density ratio. (auth)

48090 METHOD OF MEASUREMENT OF LOCAL THERMODYNAMIC PROPERTIES IN HIGH-ENERGY PLASMA JETS PRODUCED BY ELECTRIC ARC. Boffa, Cesare (Istituto di Fisica Tecnica, Turin). Calore, No. 5, 221-7(1968). (In Italian).

The means for determining the local thermodynamic properties in high-energy plasma jets, produced by means of an electric arc, have been examined. Methods employing different types of probe have been considered: the calorimetric probe, the pneumatic probe and the heat transfer probe. Also spectrometric methods have been discussed: the Larenz method and the methods based on the measure of the absolute or relative intensity of a line or of the "continuum" radiation or of the line broadening. There had been briefly examined other optical methods based on the scattering of a laser beam or on the optical interferometry. (auth)

48091 SCATTERING OF RAYS OF ELECTROMAGNETIC WAVES BY AN ARTIFICIAL IONIZED SPHERICAL CLOUD. Mar'in, N. P. Geomagn. Aeron. (USSR) (Engl. Transl.), 8: 62-9 (1968).

Translated from Geomagn. Aeron., 8: 78-87(1968).

It is shown by the method of geometrical optics that among rays forming a plane incident wave, rays can be distinguished that propagate along a trajectory twisting around the center of a sphere and rays that propagate in the opposite direction, parallel to the incident rays after bypassing the center of the sphere and escaping from it. The variation in energy flux density in the direction of reflection of a ray as a result of scattering and of absorption of electromagnetic energy in a plasma is computed. (auth)

48092 DIRECT DISPLAY OF ELECTRON TEMPERATURE IN MAGNETIZED AND TIME VARYING PLASMAS. Zakrzewski, Z.; Beaudry, C.; Cloutier, G. G. (Univ. of Montreal). Rev. Sci. Instrum., 39: 1507-10(Oct. 1968).

A method of direct display of electron temperature, which uses three closely spaced Langmuir probes at constant biases, is presented. Ion components of probe currents, which are relatively large in magnetized plasmas, are subtracted in the probe circuit. Direct display of the local value of the electron temperature is possible without any sweeping to the probe voltage. The sources of error are known and their effect can be readily evaluated during the experiment. Measurements of electron temperature in a P.I.G. discharge in hydrogen are presented as an example of application of this method. (auth)

48093 GRID PROBE AS AN IONIC DIAGNOSTIC TOOL IN CESIUM PLASMA. Haug, R.; Felden, M.; Schirmann, D. (Laboratoire de Physique des Milieux Ionises, Nancy). J. Appl. Phys., 39: 4501-8(Sept, 1968).

A plane grid probe is operated in a cesium-vapor-discharge plasma. The collected electron and ion currents are separated. The characteristic curve and its second derivative are analyzed. The densities, temperatures, and plasma potentials deduced from these curves are given and compared. (auth)

48094 COLLISIONLESS PLASMA FLOW OVER A WEDGE. Greenblatt, Marshal (Langley Research Center, Hampton, Va.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2019-21(Oct. 1968).

Theoretical predictions are presented for the ion saturation current drawn to a conducting wedge probe with a strong negative bias relative to the plasma potential. A graph is presented of the normalized current density to wedges of half-angles 0, 5, and 10° as a function of incident angles for various flow speeds (Mach angles of 0, 30, 50, and 90°). Treatments of the problem in the literature are discussed. The effects of wedge angle on the change of the current with incidence are considered. (D.L.C.)

48095 CONTINUOUS PLASMA DENSITY MEASUREMENTS FROM SPECTRAL LINE PROFILES. Stirling, A. J.; Westwood, W. D. (Flinders Univ. of South Australia, Bedford Park). Rev. Sci. Instrum., 39: 1575-6(Oct. 1968).

An eight-channel polychromator which continuously determines the profile of a broad spectral line is described. The instrument is used to obtain the electron density in a transient hydrogen plasma in the range 5×10^{14} to 1×10^{16} cm^{-3}. The measured profile of a Stark-broadened emission line from the plasma is compared with the line profiles calculated for various densities by Griem after allowance has been made for instrument broadening. In the instrument described a simple system of plane mirrors is employed to obtain the profiles of emission lines in both the visible and ultraviolet regions. (M.O.W.)

48096 ADMITTANCE PROBE METHOD OF MEASURING TIME RESOLVED PLASMA ELECTRON TEMPERATURES. Sprott, J. C. (Univ. of Wisconsin, Madison). Rev. Sci. Instrum., 39: 1569-71(Oct. 1968). (COO-1726-7).

It is shown that the plasma electron temperature in electron volts is given by the product of the ion saturation current and the probe-to-plasma resistance at the floating potential. An ac capacitance bridge circuit is described which will measure this resistance with a response time that approaches the ion transit time across the sheath. The method is demonstrated by a measurement of electron temperature in the Wisconsin toroidal octupole. (auth)

48097 LIGHT SCATTERING FROM A PLASMA IN A MAGNETIC FIELD. Platzman, P. M. (Bell Telephone Labs., Murray Hill, N. J.); Wolff, P. A.; Tzoar, N. Phys. Rev., 174: 489-94 (Oct. 10, 1968).

The scattering of light from plasmas embedded in a homogeneous magnetic field B_0 is analyzed. In the geometry where the momentum (wave vector) transferred to the system is perpendicular to B_0, the influence of the Bernstein and upper hybrid modes on the scattering is discussed. The analysis is done in some detail for a wide range of plasma parameters. Particular emphasis is placed on possible interesting experimentally observable phenomena in both gaseous and solid-state plasmas. (auth)

48098 LIMITATIONS OF APPLICATION OF CAPACITOR METHOD OF MEASUREMENT OF INTRINSIC PLASMA ELECTRIC CONDUCTIVITY. Aleksandrov, A. F.; Kuzovnikov, A. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 3, 88-92(May-June 1968). (In Russian).

Experimental studies were made of limitations of the capacitor method for measuring specific electric conductivity as a function of gas pressure. Experimental data are presented on measurements of capacitor impedance components in the presence of a positive plasma discharge column in neon between capacitor plates. Active capacitor resistance and volume were studied as functions of the discharge current at neon pressures of 0.25, 0.5, 1.25, 4.0, and 7.5 mm Hg. Electron concentrations at which the plasma capacitor resistance becomes a function of parameters of plasma ion components were found. It was also found that the concentrations increase linearly with rise of gas pressure. (R.V.J.)

48099 EVIDENCE OF LOW-BINDING-ENERGY ELECTRONS IN A LOW-TEMPERATURE HELIUM AFTERGLOW. Kaplafka, J. P.; Merkelo, H.; Goldstein, L. (Univ. of Illinois, Urbana). Phys. Rev. Lett., 21: 970-3(Sept. 30, 1968).

Moderate, pulsed microwave heating of the free electrons in a weakly ionized helium afterglow plasma at 9.5 torr at a gas temperature of 77°K produces an unusual modulation of the visible afterglow light. Observations of a second (probing) microwave signal indicate an accompanying significant increase in free-electron density under the assumption that there is no significant anomalous phase shift or absorption of the probing signal. (auth)

Kinetics of Plasma

Refer also to abstract 47781.

48100 (JINR-P9-3980) NONLINEAR GENERATION OF THE PLASMA WAVES BY THE TRANSVERSE WAVE BEAM. V. Makhan'kov, V. G.; Tsytovich, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1968. 24p. (In Russian). Dep.

Instability of bunched electromagnetic waves with respect to the excitation of the acoustic vibrations of plasma was investigated. The frequencies of the latter are a lot smaller than the frequency of the particle collisions. It is shown that two types of the acoustic vibrations can be excited. (auth)

48101 (N-68-23990) MODES OF INTERNAL MAGNETO-GRAVITY WAVES. Winterberg, F.; McLellan IV, Alden (Nevada Univ., Reno. Dept. of Physics). Oct. 1967. 77p. (NASA-CR-94616). CFSTI.

Small-amplitude low-frequency waves are treated in a plasma of infinite conductivity in the presence of magnetic and gravitational fields. In general, there are three kinds of wave motion, namely: acoustic, gravity, and hydromagnetic. In this analysis, three wave modes were found which were called the +mode, −mode, and the Alfvén mode. Each mode is strongly coupled to each of the three kinds of motions, with the exception of the Alfvén mode. The Alfvén mode is independent of compressibility and gravity, since it can be separated from the dispersion relation. The local dispersion relation is derived and expressed in a non-dimensional form independent of the constants describing a particular atmosphere. This dispersion relation is shown to exhibit the behavior of stable and unstable modes of wave propagation, which are displayed on a number of graphs and in tabular form. (auth) (STAR)

48102 (RISO-176) SIDE-PINCH EFFECT OF A MAGNETICALLY DRIVEN SHOCK TUBE WITH PARALLEL-PLATE ELECTRODES. Chang, C. T.; Korsbech, V.; Mondrup, K. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr. 1968. 21p.

For a study of the possible effect of the side pinch on the "steady-state" driving current and shock speed of a magnetically driven shock tube with parallel-plate electrodes, a semi-empirical model is formulated. The time history of the current and the radial and translational motion of the current-carrying region are expressed by three interacting nonlinear equations with five adjustable parameters describing the variation of the electric circuit elements, the geometry of the shock tube and the initial running conditions. The asymptotic behavior of the solutions is discussed analytically. The analysis indicates the existence of a quasi-steady state of the current and an oscillatory motion of the current-carrying plasmoid. With values of the parameters corresponding to our experimental setup, computational results confirm the predictions. When very strong pinches are avoided, the deviation of the current from its "steady state" (when the pinch effect is absent) in no case amounts to more than 5%. (auth) (Denmark)

48103 (SU-IPR-204) OSCILLATIONS AND TRANSPORT IN THE REFLEX DISCHARGE. Thomassen, K. I. (Stanford Univ., Calif. Inst. for Plasma Research). Oct. 1967. Contract AT(04-3)-326. 18p. Dep. CFSTI.

A cold cathode reflex discharge in a magnetic field is investigated for fields between 100 to 800 gauss at pressures near 10^{-3} torr. Instabilities excited by the primary streams of electrons which create the discharge and instabilities at low frequencies excited by the pressure gradient in the presence of the magnetic field are observed. The radial transport of plasma across the field is investigated and the behavior is linked to the amplitude of the observed low frequency fluctuations. (auth)

48104 (UUIP-593) PLASMA OSCILLATIONS IN A CONSTANT ELECTRIC FIELD. Stenflo, L. (Uppsala Univ. (Sweden). Inst. of Physics). June 1968. 7p. Dep.

The dispersion relation for longitudinal oscillations was derived for a plasma in a uniform applied electric field. The specific case was that the collision integral could be replaced by a Fokker–Planck term with distinct and energy-dependent relaxation times for momentum and energy. (auth) (Sweden)

48105 BEHAVIOR OF ANOMALOUS GLOW DISCHARGES AT PARAMETER CHANGES IN THE RANGE OF NANOSECONDS. Heisen, A.; Frank, W. (Univ., Munich). Z. Phys., 215: 213-27(1968). (In German).

On the dc potential at the cathode of an anomalous glow-discharge (potential between 500 and 1500 V, gas pressure between 8 and 25 × 10^{-2} torr) a fast rising square wave pulse with a risetime <1.5 × 10^{-9} sec and a length of 0.9 × 10^{-6} sec is periodically superimposed. The pulse level is raised up to 200 V. The investigation of the discharge current in dependence on time shows two characteristic regions: first a peak after some 10^{-9} sec and subsequently a slower current rise reaching a maximum at the end of the pulse. The first peak is explained with the formation of a positive space charge at the glowedge. The dependence of the discharge parameters on the peak shape shows, that the charge shift has the behavior of a damped plasma oscillation. Applying a simple one-dimensional theory it is possible to determine momentum transfer collision frequencies. The slower current rise can be interpreted as putting the darkspace in a stationary state of higher current density. Its relaxation time is determined by the transit time of positive ions through the dark space. (auth)

48106 KINETIC THEORY OF PLASMAS. Bernstein, Ira B. (Princeton Univ., N. J. Yale Univ., New Haven); Ahearne, John F. Ann. Phys. (N. Y.), 49: 1-38(1968).

The hierarchy of distribution-function kinetic equations for a many-body system is usually derived from the Liouville equation, incorporating the elegance of ensemble theory. In this paper emphasis is placed upon the physics of the interactions among particles and the kinetic equations are obtained by considering the time rate of change of the number of particles in phase space due to the flow of particles over phase-space boundaries. In this treatment the connection with experimental requirements is made clear and the distribution functions are identified with coarse grained space and time averages. This paper deals only with nonrelativistic, classical, structureless particles, although guidelines are given for the general treatment whenever approximations are made. The general approach developed here is used to generate kinetic equations for the one-body, the two-body equal-time, and the two-body different-time distribution functions. The remainder of the paper treats the case of an infinite homogeneous system, with a constant ionic background and only Coulomb interactions between electrons. Effective screening potentials are defined whose efficacy is greatest near thermal equilibrium. The one- and two-body kinetic equations are shown to have conservation properties and are analyzed in an energy–angular momentum phase space. The kinetic equation for the correlation function is analyzed to estimate the phase space region of validity for the truncated adiabatic form. Using the effective potentials, a formal solution for g is obtained which leads to a one-particle kinetic equation with no divergence difficulties that is a Boltzmann equation with a distribution function-dependent cross section. This kinetic equation is shown to have an H theorem to lowest significant order in the plasma parameter. Two phase-space regions are identified, based upon the influence of the effective potential, and an approximate solution for the distribution function is obtained for each region. This analysis shows that, away from thermal equilibrium, the correlation function has an inverse-power asymptotic behavior rather than exponential. Finally, the one-body kinetic equation is shown to reduce in the appropriate region to the Lenard–Balescu form. (auth)

48107 KINETIC EQUATIONS FOR TURBULENT PLASMAS. II. FLUCTUATION SPECTRUM. Ichimaru, Setsuo (Univ. of Illinois, Urbana). Phys. Rev., 174: 300-9(Oct. 5, 1968).

When the many-particle distribution functions are constructed by summing all possible products of the single-particle distribution functions and the pair-correlation functions, the BBGKY hierarchy exhibits a modification in the effective interaction owing to the presence of the finite correlations; the pair-correlation function as well as the single-particle distribution develops in time with inclusion of the correlation effects in its kinetic equation. The second member of the hierarchy is solved in the fluid limit, assuming that the plasma is in a weakly turbulent stationary state. A dielectric response function of such a turbulent plasma is thereby obtained; an integral equation that self-consistently determines the energy spectrum of turbulence is then derived. A simplification of this equation arising in connection with certain experimental applications is also discussed. It is shown that the solution of the equation leads to a positive energy spectrum for both turbulent and quiescent plasmas. (auth)

48108 TRANSPORT THEORY OF A PARTIALLY DEGENERATE PLASMA. Lampe, Martin (New York Univ., N. Y.). Phys. Rev., 174: 276-80(Oct. 5, 1968).

The transport coefficients of a high-temperature, weakly coupled plasma of nondegenerate ions and partially degenerate electrons (i.e., stellar matter) are calculated by means of a Chapman–Enskog solution of the quantum Lenard–Balescu kinetic equation. Both electron–electron and electron–ion collisions are included. The leading term of the transport coefficients, the Coulomb logarithm, is evaluated exactly and relatively simply for all degrees of electron degeneracy. Dynamic shielding and other corrections to the term of order unity, which follow the larger logarithm, have been neglected. The method is applicable to any partially degenerate system with weak, long-range particle interactions. (auth)

48109 KINETIC EQUATIONS FOR TURBULENT PLASMAS. I. QUASILINEAR THEORY. Ichimaru, Setsuo (Univ. of Illinois, Urbana). Phys. Rev., 174: 289-300(Oct. 5, 1968).

The Vlasov equation is not applicable for those turbulent plasmas in which certain higher-order correlation functions may play just as important a part as the single-particle distribution function. The many-particle distribution functions are constructed by summing certain selected products of the single-particle distribution functions and the pair-correlation functions, and it is shown that, in the Rostoker–Rosenbluth fluid limit, those distribution functions satisfy the Bogoliubov–Born–Green–Kirkwood–Yvon (BBGKY) hierarchy and enable truncation of it at the second equation. The resulting equations contain an asymmetric feature in that the single-particle distribution function develops in time with inclusion of the correlation effects in the collision term, while the time evolution of the pair-correlation function is governed by a solution of the linearized Vlasov equation. It is shown explicitly that those kinetic equations become identical to the quasilinear equations without mode coupling if the contribution of the growing plasma oscillation is singled out in the pair-correlation function. (auth)

48110 MODELLING OF PLASMAS: ATOMISTIC AND COMPUTERIZED. Rosenbloom, J. H. Res. Rev. (Office Aerosp. Res.), 7: No. 5, 9-12(May 1968).

Models of material substances are usually either (1) atomistic many-body or (2) phenomenological. The difficulties in using the atomistic approach and some early attempts to overcome them are described. The application of computer modeling techniques to the case of anomalous plasma diffusion is considered in detail. The steps followed in calculating the trajectories of each of the 1,000 charged particles are outlined. The results show an anomalous diffusion of charges from the plasma to the wall; a movie display shows a quasi-steady state with no diffusion followed by the onset of a macroscopic plasma wave. The diffusion oscillates between an electron-transmitting state and a positive-ion-transmitting state. The advantages of the atomistic computer modeling over phenomenological approaches are given, and future possibilities are considered. (D.L.C.)

48111 VLF ELECTROMAGNETIC RADIATION IN A MAGNETOIONIC MEDIUM. Snyder, Martin Avery; Weitzner, Harold (New York Univ., N. Y.). Radio Sci., 3: 943-54(Sept. 1968).

The passage of vlf electromagnetic radiation through an ionized gas in a permanent magnetic field (magnetoionic medium) is examined. Such a medium can be taken as a model of the ionosphere. One works from the Fourier transform of the dyadic Green's function which relates the current density and the electric field. Asymptotic expansions of the function are obtained for both small and large separation. The expansions for small separation can be used to discuss the power radiated by a current distribution (antenna). Special attention is given to the power radiated by a Hertzian dipole, and a conflict in the literature (Staras, 1964; Lee and Papas, 1965) is resolved. The expansion for large separation can be used to discuss the far field. The radiated far field is shown to propagate most strongly along the field lines of the permanent magnetic field. The far field radiated by a Hertzian dipole is considered. (auth)

48112 INFLUENCE OF ANODE ORIENTATION ON THE CHARACTERISTICS OF A LOW-PRESSURE DISCHARGE IN A TRANSVERSE MAGNETIC FIELD. Kervalishvili, N. A. (Inst. of Physics, Tbilisi, USSR). Zh. Tekh. Fiz., 38: 637-45(Apr. 1968). (In Russian).

This is a continuation of earlier work (Zh. Tekh. Fiz., 35: 2194 (1965)) where it was observed that the orientation of the anode relative to the direction of the magnetic field affects the discharge current and the thickness of the anode layer. The present paper reports results of an experimental study of the dependence of the characteristics of the discharge on the angle between the axis of the anode and the magnetic-field vector. The experimental setup was similar to that used in an earlier paper, and employed a geometry of the inverted magnetron type. The tests consisted of measurements of the energy distribution of the ions accelerated in the anode layer, measurement of the distribution of the electron

current along the radius of the discharge, and plotting the volt–ampere characteristic of this current. The results show that the characteristics of the discharge and the visually observed picture depends strongly on the orientation of the anode relative to the direction of the magnetic field. This dependence remains the same at all investigated discharge parameters and is governed by a common parameter proportional to the angle. The anode layer remains concentric and coaxial with the cylindrical anode at all anodes between the anode axis and the magnetic field direction. At certain values of the parameter, the anode layer splits in two. At zero angle, the electron current to the cathode discs amounts to about half the total discharge current. (ATD)

48113 LAWS GOVERNING THE FORMATION OF A SPARK IN THE NANOSECOND TIME RANGE IN THE CASE OF STATIC BREAKDOWN OF A GAP. Mesyats, G. A.; Korshunov, G. S. (Tomsk Polytechnic Inst., USSR). Zh. Tekh. Fiz., 38: 646-54 (Apr. 1968). (In Russian).

This is a continuation of earlier investigations which demonstrated the validity of the Rompe–Weizel deductions for time durations shorter than 10 nanoseconds (Izv. Energet., 12: 31(1961)). The present paper is devoted to a more detailed and theoretical and experimental study of spark formation in a gap in the nanosecond range. The authors first verify theoretically the laws of applicability of the relations derived on the basis of the Rompe–Weizel relations, namely that the conductivity of the plasma in the discharge channel is directly proportional to the internal energy. The theoretical formulas were checked experimentally for air-gap lengths 0.005 to 3.5 cm at pressures 1 to 6 atmospheres using a special developed spark chamber and recording apparatus having a resolution of 10^{-10} sec. The results obtained are in good agreement with the theory for spark durations less than 10^{-8} sec and also in good agreement with the results by others. (ATD)

48114 PLASMA MOTION IN A RADIAL MAGNETIC FIELD. Vasil'eva, R. V.; Donskoi, K. V.; Dobrynin, B. M. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 655-60 (Apr. 1968). (In Russian).

The interaction between a moving plasma produced in a shock tube and a radial magnetic field produced in an annular region situated between the internal core of an electromagnet and an external magnetic yoke was investigated. The field was not strong enough to produce appreciable dynamic interaction between the plasma and the field. The experiment consisted of measuring the induced annular current, the Hall voltage along the tube axis, and the Mach number of the shock wave. Shock-wave theory was used to calculate the direction of velocity of the particles, the thermal velocity of the electrons, and the density of the normal atoms. The measured and calculated data were used to determine the conductivity of the plasma, the charged-particle density, and the cross sections for elastic collisions between the electrons and the atoms. It is concluded that this method is particularly advantageous at low electron energies, for which the published data for many gases are contradictory. The method is also useful in the diagnostics of multicomponent gas mixtures, when the concentrations of the individual components and their contribution to the collisions are not known. (ATD)

48115 INFLUENCE OF STRIATIONS ON THE ELECTRON ENERGY DISTRIBUTION IN A MERCURY–KRYPTON MIXTURE. Ostapchenko, E. P.; Oreshak, O. N.; Stepanov, V. A. Zh. Tekh. Fiz., 38: 661-2(Apr. 1968). (In Russian).

The electron energy distribution in a discharge tube of 60 mm diameter was measured as a function of the krypton pressure (0.003 to 4 mm mercury) at a mercury pressure 0.0013-mm Hg. The results revealed considerable deviations from a Maxwellian distribution at krypton pressures 0.0035- to 0.3-mm Hg, but a Maxwellian distribution at pressures 1 and 4 mm Hg. A correlation is established between the character of the electron energy distribution and the striation oscillations of the plasma. The presence of striations was established by measurements of the length, velocity, distribution, and amplification of the oscillations in the discharge column from the cathode to the anode. A larger striation amplitude corresponds to larger deviation of the distribution from Maxwellian. The same conclusion is confirmed by plotting the probe characteristic. (ATD)

48116 SHORT CIRCUITING OF A DISCHARGE GAP BY A PLASMA JET. Azizov, E. A.; Komel'kov, V. S. Zh. Tekh. Fiz., 38: 628-36(Apr. 1968). (In Russian).

This is a continuation of earlier work and is devoted to a more detailed study of the closing of a high-vacuum discharge gap under conditions when the vacuum is high enough (below 10^{-4} mm mercury) so that no self-maintaining discharge can be produced. Consequently, a plasma jet is injected from a strong coaxial injector. The voltage between the electrodes, which are both annular, ranges from 0.5 to 30 kV, and the jet moves from the grounded electrode to the high-voltage electrode. The delay of the breakdown is investigated as a function of the characteristics of the jet, of the electric voltage, the longitudinal magnetic field, and other factors. The experimental setup is described in some detail. The tests show that the character of the discharge buildup, the current wave form, and the delay of the discharge depend strongly on the polarity, on the voltage on the electrodes, and particularly on the density and velocity of the plasma jets. At voltages below 2 kV, the entire interelectrode gap must be subtended by a jet of density 10^{15} cm^{-3} and larger. At larger voltage, breakdown occurs in regions with concentration 10^{13} cm^{-3} and lower. At negative polarity the wave form of the current varies little and the current growth occurs without oscillations. At positive polarity the short-circuiting process stretches out in time and is accompanied by high-frequency oscillations. The presence of a magnetic field does not reduce the effect of the polarity. The greatest probability for the appearance of oscillations is the anode section of the chamber, where the electron velocity is much larger than the jet velocity, thus producing a positive space charge. (ATD)

48117 CRITICAL CURRENTS OF AN ELECTRON BEAM IN A PLASMA. Raizer, M. D.; Rukhadze, A. A.; Strelkov, P. S. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 38: 776-9(Apr. 1968). (In Russian).

This is a continuation of earlier work (Zh. Eksp. Teoret. Fiz., 63: 1720(1967)) dealing with the instability of an electron beam in a plasma. In the present paper it is shown by an analysis of the equation for the critical current, that stability can be obtained provided the plasma can be neutralized before the beam is injected in the plasma. It is pointed out, however, that while such a procedure eliminates hydrodynamic instability, it does not eliminate various kinetic instabilities, particularly slipping instability, due to the inhomogeneity of the translational velocities of the beam electrons. It is also pointed out that the slipping instability is the most dangerous one. (ATD)

48118 STATIONARY EQUILIBRIUM OF A TOROIDAL PLASMA. Karlson, Erik T. (Princeton Univ., N. J.). Ark. Fys., 35: 539-50(1968).

The stationary equilibrium of a low-density plasma in toroidal geometry was studied theoretically. The effects of resistivity, inertia, and viscosity were taken into account. It is assumed that plasma was injected with a source density rate Q and a velocity u which may or may not be equal to the local plasma velocity v. It was found that there is always a unique equilibrium solution. For the case u = v and zero viscosity, the only possible motion is a constant velocity parallel to the magnetic axis. If a viscosity term is introduced, a constant angular velocity around the magnetic axis becomes possible. The diffusion rate is the one given by Pfirsch and Schlueter. (Sweden)

48119 CURRENT LIMITATION AND ELECTRICAL GAS CLEAN UP IN A LOW-PRESSURE MERCURY DISCHARGE. Torven, Staffan (Chalmers Univ. of Technology, Goteborg). Ark. Fys., 35: 513-26(1968).

A long and narrow discharge tube was employed allowing investigations of current limitation at low current levels. The tube was mounted on a cathode system in which the vapor pressure was constant and approximately independent of current. Measurements of the number of atoms in the ground state (by absorption of resonance line radiation) showed that an increase of current always resulted in a local vapor rarefaction somewhere in the discharge column. Two limiting cases could be distinguished. If the current was increased very rapidly, the most important rarefaction mechanism was electrical clean up of atoms to the wall of the discharge tube. When gas inflow from the cathode region could not compensate for cleanup, the vapor density gradually decreased until current interruption occurred at a definite minimum density. If the current was increased very slowly (i.e., stationary discharge) a rarefaction appeared at the anode side of the electrical double sheath joining the cathode plasma and the column. The current limit in this case was at least two orders of magnitudes larger than in the previous case. (Sweden)(auth)

48120 INTENSITY DEPENDENCE OF THE INVERSE BREMSSTRAHLUNG ABSORPTION COEFFICIENT IN HOT PLASMAS. Hughes, T. P.; Nicholson-Florence, M. B. (Univ. of Essex, Eng.). J. Phys., A (London), 1: 588-95(Sept. 1968).

The net absorption coefficient, allowing for stimulated emission, is derived for intense light in a hot nonrelativistic plasma, using a semi-classical approach, which takes into account the non-Maxwellian velocity distribution caused by the strong electric field of the radiation, but considers only absorption and emission processes involving a single incident photon. The absorption coefficient is found to vary inversely as both the electric field and the frequency, a result intermediate between the usual weak-field coefficient and a strong-field coefficient due to Rand (Phys.

Rev., 136: B231-7(1964)), which is intended to include multi-photon processes. It appears that the net effect of multi-photon processes is to produce stimulated emission. Rand's result is shown to imply that, in order to heat plasma to a given temperature, a minimum time and (on a simple dynamic model) a minimum quantity of plasma are necessary. (auth) (UK)

48121 BOUNDARY CONDITIONS IN WALL-STABILIZED ARC COLUMNS. George, D. W.; Richards, P. H. (Central Electricity Generating Board, Southampton, Eng.). J. Phys., D (London), 1: 1171-82(Sept. 1968).

Conduction and breakdown were studied in the boundary regions of wall-stabilized arc columns for arc currents up to 50 A in N_2, Ar, He, air, and SF_6 at atmospheric pressure, and for stabilizing hole diameters of 5 and 4 mm. In the case of SF_6 no electrons could be drawn to a positively charged disk, and this is shown to be due to an unusual property of an SF_6 plasma below 4000°K, namely that it comprises only positive and negative ions (S^+ and F^-). Estimates of temperature on the plasma side of the boundary layer, based on the magnitudes of the positive-ion currents, vary from 2800°K in SF_6 to 4800°K in N_2 for 25-A arcs in 5-mm-diameter holes. Some characteristics of unipolar arcs, which are defined as arcs which join a metallic electrode to a plasma, are given for Ar and SF_6. (auth) (UK)

48122 FIELD DISTRIBUTION OF THE FORWARD-WAVE PLASMA-GUIDE MODE ON A MAGNETISED PLASMA COLUMN. Gupta, K. C.; Singh, A. (Central Electronics Engineering Research Inst., Rajasthan, India). Electron. Lett., 4: 378-9(Sept. 1968).

It is shown that, for delay ratios less than $\sqrt{\epsilon_t}$ (where ϵ_t is the transverse component of the equivalent permittivity tensor), the forward-wave plasma-guide mode on a longitudinally magnetized plasma column changes its field distribution from that of a bulk wave to that typical for surface waves. (auth) (UK)

48123 ON A HIGH-β REFLECTED WAVE IN A CUSPED MAGNETIC FIELD. Hirano, Katsumi; Irisawa, Juichi; Shimazaki, Sotaro; Nakano, Yoshiei (Tokyo Inst. of Tech.). Jap. J. Appl. Phys., 7: 1298-9(Oct. 1968).

The reflected wave in a cusp field in which a gun plasma is introduced through an entrance point cusp was studied. Helium was used as a propellent gas. The field strength at the point cusp is variable up to 7 kG and the ring cusp is in the vacuum system. The cusp coil is crowbered when the current attains its first peak value. The plasma is ejected from the gun muzzle with about 5 μsec of the pulse width and 1×10^7 cm/sec of the directed velocity, about 1.5 μsec after the gun firing. According to an electrostatic probe measurement, the electron density of the plasma is 9×10^{13} cm^{-3}. The distance between the midplane of the cusp and the gun muzzle is 33 cm. The base pressure of the vacuum system is 3×10^{-6} mmHg. (M.O.W.)

48124 EXCITATION OF PSEUDOWAVES IN A PLASMA VIA A GRID. Alexeff, I. (Oak Ridge National Lab., Tenn.); Jones, W. D.; Lonngren, K. Phys. Rev. Lett., 21: 878-81(Sept. 23, 1968).

When a time-varying potential is placed on a grid located in a plasma, coherent bursts of charged particles having peak energies corresponding to the applied potential are emitted from the grid region. These ion bursts produce an ion-wavelike phenomenon, which is not predicted by the ordinary dispersion relation. "Pseudowaves" having wavelengths larger than the Debye radius were observed, which suggests that in this case some cooperative electrostatic process must be present. These pseudo ion waves have been used as a tool to study plasma phenomena. (auth)

48125 STUDIES OF PULSED DISCHARGES IN COOLED VACUUM CATHODES. Dobrosavlevich, E. S.; Zhiglinskii, A. G.; Khlopina, T. N. (Leningrad State Univ.). Bull. Boris Kidric Inst. Nucl. Sci., Phys., 19: No. 1, 1-6(Jan. 1968). (In Russian).

The possibility of time separation of the excitation process and gas heating in a liquid-air-cooled hollow-cathode discharge was investigated. The purpose was to obtain both intense and narrow spectral lines. The apparatus used and the experimental results obtained during the investigation of the impulse discharge are presented, and a comparison with the stationary discharge is made. With the same gas temperature in the impulse discharge, the intensity of the lines was 5 times higher than that obtained in the stationary discharge. In studying the weak lines, the impulse hollow cathode described, has proved to be particularly suitable using an impulse synchronous detection scheme. (auth)

48126 MOTION OF AN ELECTRIC ARC IN A TRANSVERSE MAGNETIC FIELD. Hingst, W. R. (Lewis Research Center, Cleveland). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2016-18(Oct. 1968).

Magnetically induced arc motion was studied in two parallel cylindrical ring electrodes; a radial magnetic field normal to the electrodes was established by electromagnets around the electrodes. The arc velocity u in argon was measured as a function of the field B, arc current I, electrode spacing, and gas pressure P. After an arc-velocity transient period (~30 sec) during which the electrodes stabilized, the following relationship was found: $u \propto B^{0.575} I^{0.385} p^{-0.39}$. The irregular arc motions that occurred at the extremes of the variables are described. (D.L.C.)

48127 SPECTROSCOPIC STUDY OF EXCITED STATES IN AN ARGON PLASMA. Frost III, Milton A. (General Dynamics, Fort Worth, Tex.); Wierum, Frederic A. Jr. AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 6: 2043-4(Oct. 1968).

A method is presented for analysis of data obtained from a decaying argon plasma jet. Equations are derived for the excitation and de-excitation rates and the recombination coefficient. A graph is presented of de-excitation rate coefficients for various transitions in argon and helium. (D.L.C.)

48128 ON THE HYPER-GEOMETRIZATION OF RELATIVISTIC PHASE-SPACE FORMALISM. I. Horvath, J. I. (Jozsef Attila Univ., Szeged). Acta Phys. Acad. Sci. Hung., 24: 205-23 (1968).

In order to define the relativistic phase space at every point of the space–time continuum a local momentum space formed by the momentum four-vectors of the gaseous particles has to be introduced. Keeping in mind that the length of the momentum vectors is proportional to the rest mass of the particles, in the case of homogeneous gas systems, a three-dimensional hypersurface — the so called mass shell — is spanned by the radius vectors of the momentum space, i.e., its dimensionality is reduced and, in fact, the relativistic phase space is (4 + 3)-dimensional defined as the direct product of the four-dimensional space–time continuum and the three-dimensional local momentum space. In this first part, the geometrical structure and symmetry properties of the relativistic phase space are intuitively investigated — for the sake of simplicity having the special case of a pseudo-Euclidian space–time background in mind — and it is shown that the geometrical and physical properties of the system can be geometrized in a very natural way in terms of line-element geometry. In this geometry, the phase functions are dependent not only on the points of the space–time continuum but on all points on the directions — i.e., on the directions of the momentum four-vectors. This means, however, that by the dependence of the phase functions on the directions it is precisely the dynamical properties of the system which are characterized. The method of the characterization of the dynamical relations via the dependence of the phase functions on the directions may be denoted as hypergeometrization. Finally, it is demonstrated that, on the basis of the proposed method, a new foundation of the bilocal theory of fields can be suggested. (auth)

48129 A PROCEDURE FOR THE APPROXIMATE EVALUATION OF THERMODYNAMIC DATA OF SUPERHEATED GAS MIXTURES. II. THE EVALUATION OF ENTHALPIES, ENTROPIES, COMPRESSIBILITIES, AND RELATED PARAMETERS. Kuthe, Rolf (Technische Hochschule, Brunswick). Brennst.-Chem., 48: 73-7(1967). (In German).

A procedure is described for estimating the enthalpy, entropy, compressibility factors, and related parameters of superheated gases or plasmas that are composed of at least 2 chemical elements in various mixture ratios. The values can be calculated for temperature ranges where the mixture contains only neutral atoms, ions, and free electrons, for arbitrary mixture ratios, provided that the relevant numerical values for 2 plasma mixture ratios are known. The procedure is based on the relation that with certain thermodynamic functions the difference between the numerical values for 2 mixture ratios divided by the difference of the related mixture ratios is practically independent of mixture ratios affected, over a wide range of temperature. By a simple modification of the method described, it is possible to represent the entire range of numerical values that relate to the calculation of thermodynamic functions of "mixed plasmas" in markedly reduced form. As an example, the accuracy of various thermodynamic magnitudes of air/C plasmas containing from 0 to 75% of C are calculated. (BBB)

48130 A PROCEDURE FOR THE APPROXIMATE EVALUATION OF THERMODYNAMIC DATA OF SUPERHEATED GAS MIXTURES. I. THE EVALUATION OF EQUILIBRIUM COMPOSITION. Kuthe, Rolf (Technische Hochschule, Brunswich). Brennst.-Chem., 47: 356-60(1966). (In German).

A procedure is described for evaluation of the equilibrium composition and the compressibility factor of a superheated plasma gas mixture in the temperature ranges where the plasma

consists only of neutral atoms, ions, and free electrons. The procedure is valid for several mixture ratios where the composition for at least one mixture ratio is known. The procedure is based on the almost linear relation between mixture ratio of a plasma and the mole numbers of the single components and the compressibility factor, over a broad range of concentrations. The accuracy of the method described increases the less the ionization energies of the single plasma components differ, and the less the mixture ratio of the plasma mixture measured is changed as compared to the initial mixture. As an example of the accuracy of this evaluation method, the composition and the compressibility factor of an air/C plasma for several mixture ratios are evaluated. (BBB)

48131 NONLINEAR INTERACTIONS OF ELECTROMAGNETIC WAVES WITH A THERMALLY GENERATED CESIUM PLASMA. Hewitt, Jack G. Jr.; Boone, Jack L. (Univ. of Denver). J. Appl. Phys., 39: 4617-23(Sept. 1968).

The interaction of a large-amplitude disturbing wave with a thermally generated, highly ionized cesium plasma has been investigated using a small-amplitude sensing wave as a probe. The subsequent interaction between the disturbing and sensing waves is related to the plasma electron temperature. The plasma was contained in a magnetic field of 500 to 1000 G and had an electron plasma frequency near 10 GHz and an electron gyromagnetic frequency around 2 GHz. The sensing wave was a 10-GHz plane wave of approximately 1.5-mW input power and the disturbing wave was 7.5-GHz plane wave of about 1.2-W peak power. Measurements of the sensing-wave transmitted power were made using standard microwave techniques. A notch filter in the sensing-wave receiving circuit reduced the scattered disturbing-wave interference to an immeasurably low level. Langmuir probes were used to detect disturbing-wave modulation and to measure plasma temperatures and densities. Measurements of the interaction were correlated with a solution of the Boltzmann transport equation for a perturbed Maxwellian distribution function with binary Coulomb collisions. (auth)

48132 BUNCHING OF ELECTRONS IN THE MENISCUS DISCHARGE. Weinreb, J.; Ettinger, Y. (Technion–Israel Inst. of Tech., Haifa). J. Appl. Phys., 39: 4816-19(Sept. 1968).

The parameters of a meniscus discharge in mercury at low pressure were examined by means of a movable probe. The probe was also used as an antenna for the detection of high-frequency oscillations generated in the discharge. By applying the electron-bunching theory, it is quantitatively explained that strong oscillations are observed in a sheath located at a small distance from the meniscus top, at the side of the anode, while an oscillating electric field is located in a narrow region near the meniscus top. Calculations of the distance between the two sheaths, using the klystron theory of Webster, are in good agreement with the experimental data. (auth)

48133 EFFECTS OF ELECTRON-DENSITY FLUCTUATIONS ON PLASMA-COLUMN RESONANCES. Johnson, C. D.; Berry, L. A.; Nickel, J. C. (Univ. of California, Riverside). J. Appl. Phys., 39: 4481-5(Sept. 1968).

A theory describing the interaction between electron-density fluctuations and the main dipole resonance of the Dattner spectrum is presented. The results of the theory are compared with experiment, and it is found that the fluctuations can substantially modify the resonance shape. (auth)

48134 PLASMA: THE FOURTH STATE OF AGGREGATION. Schulz, Paul. Bild Wiss., 5: 518-27(June 1968). (In German).

The plasma state is described operationally in terms of a gas discharge, and then defined precisely. Properties of the plasma state are described in terms of the gas state, and comparisons of properties are drawn. Motion of the charged species present in the plasma is determined, and concepts of electron and neutral gas temperatures developed. Techniques for preparation of thermal plasmas are listed. Spectral properties of thermal plasmas are described; in particular, the nature of pressure broadening of spectral lines is illustrated, with the 1014-nm line of Hg as an example. Electron collision broadening, such as that of the 577-nm line of Hg, is also explained. Electron density measurements by collision broadening are described. Applications to astrophysics, such as stellar density and description of stellar interiors, especially aspects of nuclear fusion processes, are noted, as well as applications to industrially important phenomena like those of the Xe high-pressure discharge lamp. (BBB)

Production of Plasma

Refer also to abstract 47870.

48135 THE POSSIBILITY OF PRODUCING A DENSE THERMONUCLEAR PLASMA BY AN INTENSE FIELD EMISSION DISCHARGE. Winterberg, F. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., 174: 212-20(Oct. 5, 1968).

It is shown that it may be possible to produce a dense thermonuclear plasma by irradiating a liquid or solid T–D target with electrons or ions from an intense field emission discharge. It may also be possible to generate a beam of microparticles resulting from the disintegration of the field emitter anodes by this method. The energy for the discharge can be supplied by conventional capacitor banks in the megajoule range using the Marx circuit technique, or, perhaps more efficiently, by an electrostatic energy system based on charging a superconducting ring to very high voltages. (auth)

48136 AN EXPERIMENTAL INVESTIGATION OF THE DEVELOPMENT OF STREAMER BREAKDOWN IN NEON. Davidenko, V. A.; Dolgoshein, B. A.; Somov, S. V. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz., 55: 435-42(Aug. 1968). (In Russian).

The development of an electron discharge in pure neon and in neon with a molecular impurity is studied with aid of an image converter. The dependence of development rate of the "forward" and "backward" streamer on the electric field strength and length of the streamer is measured. Possible mechanisms of photoionization of the gas are considered. (auth)

48137 TURBULENT HEATING OF IONS BY MAGNETOHYDRODYNAMIC WAVES. Aref'ev, V. I. Zh. Eksp. Teor. Fiz., 55: 679-90(Aug. 1968). (In Russian).

The problem of turbulent heating of a plasma by quasiperiodic MHD waves of finite amplitude is considered. It is shown that as a result of instability of the current, oscillations with frequencies $\omega_{Hi} \ll \omega \ll \omega_{He}$ are excited in the plasma. The excitation threshold with respect to the current velocity in the case of hot ions with $T_i \gg T_e$ lies beneath the mean thermal ion velocity. Interaction between the ions and oscillations is considered on basis of the equations for a weakly turbulent plasma. Ion scattering on the vibrations is quasielastic. An equation is derived for the rate of ion heating. Anomalous attenuation of MHD waves observed in a number of experiments is discussed. (auth)

Stability of Plasma

48138 (TID-24688) ION RESONANCE INSTABILITY IN GROSSLY NON-NEUTRAL PLASMAS. Research Report 302. Levy, R. H.; Daugherty, J. D.; Buneman, O. (Avco-Everett Research Lab., Everett, Mass.). July 1968. Contract AT(30-1)-3863. 56p. Dep. CFSTI.

The addition of a certain fraction of ions to an otherwise stable cloud of electrons can, in certain circumstances, result in an instability. The case of a low-density ($q = \omega_p^2/\omega_c^2 \ll 1$) electron cloud, in which the electron motions can be described by $\underset{\sim}{E} + \underset{\sim}{v}_e \times \underset{\sim}{B} = 0$, is considered in detail. The condition for onset of the instability is that the unperturbed ion orbits (which characteristically traverse the entire electron cloud) should involve frequencies close to that of the diocotron wave that can propagate on the electron cloud. This condition is equivalent to having the ratio Zm_e/m_iq of the order of unity and is independent of the ion density. When instability is present, the growth rate of the order of the ion plasma frequency. (auth)

48139 THRESHOLDS OF BEAM INSTABILITIES. Nezlin, M. V.; Taktakishvili, M. I.; Trubnikov, A. S. Zh. Eksp. Teor. Fiz., 55: 397-414(Aug. 1968). (In Russian).

The thresholds (critical currents) for excitation of electron–ion beam and drift-beam instabilities and also the spatial structure and dispersion properties of the induced electron–ion oscillations are investigated experimentally. The results obtained confirm the existing linear theory of instability of charged particle beams in a plasma. A manifestation of both types of instability is the anomalous diffusion of the plasma across an external magnetic field and the acceleration of the plasma ions to energies comparable to those of the electron beam. One of the instabilities (drift-beam) is the cause of restriction (cutoff) of the current in a quasi-neutral electron beam. (auth)

Shielding

Refer also to abstracts 48388 and 48421.

48140 (BMwF-FBK-68-12) ANALYTICAL TREATMENT OF ARBITRARY ANISOTROPIC SCATTERING IN THE ENERGY-DEPENDENT TRANSPORT THEORY. Gerstl, S. A. W. (Technische Hochschule, Karlsruhe (West Germany). Institut fuer Struktur der Materie). Apr. 1968. 4p. (In German). Dep.

A general method is outlined to solve the one-dimensional en-

ergy and angular dependent transport equation in slab geometry, whereby any anisotropy of the scattering cross section can be treated analytically exact. The angular dependency of the scattering cross section is described in a very general form by means of "anisotropy functions" for which detailed analytic expressions and recurrence formulas are stated. The quality of this method is demonstrated by shielding calculations for gamma rays. Here, the spectra of the transmitted and reflected energy flux show new discontinuities which attain immediate physical interpretations but were not minded before. (auth)

48141 THE PROBLEM OF THE NEUTRON DIFFUSION: A SURVEY. Pignedoli, Antonio (Univ., Bologna). Meccanica, 3: 69-80(June 1968).

Researches done by author and others on the theory of the diffusion of neutrons in a moderating medium are expounded from the point of view of "phenomenological theory" and of "transport integro-differential equations". In particular, the transformational methods with a rigorous analysis for the case of "slab geometry" are considered. 35 references. (auth)

48142 COMPARISON OF THE EXACT SOLUTION ACCORDING TO THE SPHERICAL FUNCTION METHOD AND THE CASE METHOD FOR LINEAR ANISOTROPIC SCATTERING LAWS FOR MONOENERGETIC HALF SPACE PROBLEMS. Mehner, Juergen (Univ., Karlsruhe, Ger.). Nukleonik, 11: 182-7(July 1968). (In German).

A special method developed by Kofink is used to solve exactly the Milne problem with anisotropic scattering in the limiting case of infinitely high approximation. This solution is given in integral representation. By means of this standard example of neutron transport theory one obtains a relation between the X function of Case's method and the h function, a generalized Chandrasekhar H function. This relation is not restricted to the Milne problem, but is valid for all monoenergetic and time-independent half-space problems as well as slab problems. In addition, the transition from the approximate eigenfunctions to the exact eigenfunctions of the Case-method is accomplished. (auth)

48143 SOME CONSIDERATION OF DOSE BUILDUP FACTOR FOR A ^{60}Co CYLINDRICAL SOURCE WITH SHELL-SHAPED SHIELD. Furuta, Yutaka (Japan Atomic Energy Research Inst., Tokyo); Kanemori, Yoshihiko. Nucl. Sci. Eng., 3: 340-54(1968).

The contribution of gamma rays from a source-element to local variations was analyzed experimentally. Some conclusions are given. (M.H.R.)

48144 MONTE CARLO INTEGRATION OF THE ADJOINT GAMMA-RAY TRANSPORT EQUATION. Kalos, M. H. (New York Univ., N. Y. Mathematical Applications Group, Inc., White Plains, N. Y.). Nucl. Sci. Eng., 33: 284-90(1968).

The adjoint transport problem for gamma radiation is formulated and prescriptions for its Monte Carlo solution are given. Emphasis is put upon requirements for calculation of effects in shielding against fallout and the differential effect of source position. Results are given for two situations: a detector three feet above a uniform infinite source of 1.25-MeV photons, and another detector placed in an open pit with a similar source. (auth)

48145 TRANSMISSION OF GAMMA-RAYS FROM ^{60}Co MONODIRECTIONAL SOURCE THROUGH SLABS OF POLYETHYLENE AND IRON. Umeda, Iwao (Nippon Kokan K.K., Yokohama, Japan); Hyodo, Tomonori. J. Nucl. Sci. Technol. (Tokyo), 5: 397-407(Aug. 1968).

Scattered γ rays were measured with 5-in.-diameter by 5-in.-long NaI(Tl) scintillator for the purpose of obtaining information on the transmission of ^{60}Co γ rays incident to polyethylene and iron slabs, and layered combinations thereof. The primary γ rays were collimated, and the detector was used without collimator. The spectra of scattered γ rays above 300 keV were quite similar to each other irrespective of material and thickness when the scattering angle and scatterer thickness in mean free path units were normalized. (auth)

48146 ELECTRON MOMENTA IN MONTE CARLO X-RAY TRANSPORT. Veigele, Wm. J. (Kaman Nuclear, Colorado Springs). J. Appl. Phys., 39: 4781-3(Sept. 1968).

Monte Carlo x-ray transport codes presently in use neglect momenta of scattering electrons. These momenta cause the Compton scattered wavelength to assume a distribution of wavelengths which is observed as a scattered photon linewidth. This linewidth was included in a Monte Carlo code using a point-source monoenergetic emitter in a homogeneous, infinite, high-atomic-number material, and transport parameters were calculated from one to ten mean free paths of the source photon. Results indicate that linewidth does not significantly influence energy deposition or fluence calculations for the cases considered. (auth)

Solid-State Physics

Refer also to abstracts 47330, 47416, 47417, 47419, 47422, 47442, 47673, 48435, 48553, and 48608.

48147 (AERE-Trans-1103) SIMULATION OF THE RANDOM MOTION AND QUASI-CHEMICAL REACTIONS OF POINT DEFECTS IN CRYSTALS BY MEANS OF ELECTRONIC COMPUTERS. Scholz, A. Translated by J. B. Sykes (Atomic Energy Research Establishment, Harwell, Eng.), from Phys. Status Solidi, 14: 169-79(1966). 25p. Dep. CFSTI. UK 4s.

Interconversions of point defects can be described by quasi-chemical reactions, which are mathematically expressed by reaction kinetic equations, which in the steady state give the laws of mass action. An electronic computer was used to simulate defect reactions in fcc crystal lattices, ALGOL being used for programming. Simulation of the reaction processes was equivalent to treating the equations by Monte Carlo methods. The simulation process is explained in detail, with samples. (UK)

48148 (BNL-12711) INFLUENCE OF INTERSTITIAL CARBON IN IRON ON THE SCATTERING OF X RAYS. Goland, A. N.; Keating, D. T. (Brookhaven National Lab., Upton, N. Y.). [1968]. 15p. (CONF-680910-1). Dep. CFSTI.

From International Conference on Vacancies and Interstitials in Metals, Juelich, Germany.

With the aid of recent calculations of the doublet-force displacement field about a carbon interstitial in α-iron, the x-ray diffuse scattering was calculated in the vicinity of the reciprocal lattice points in iron-carbon martensite and in ferrite. Contours of the diffuse scattering in electron units per iron atom divided by p(1-p), where p is the fraction of carbon atoms, are given for both martensite and ferrite. In martensite, the contours are of a complicated shape, often quite different from those for defects with spherical symmetrical symmetry. Reflections of the type (OOL) and (HKO) always show nodal planes perpendicular to the vector from (OOO) to (HKL). The diffuse scattering at (OOO), the small angle scattering shows the cylindrical doublet symmetry. In ferrite, the contours are even more complicated, some displaying no nodal surfaces. Reflections of the type (HOO), (OKO), or (OOL) show nodal planes perpendicular to the vector from (OOO) to (HKL). The results for martensite and ferrite reveal that the origin scattering exhibits the orientation and symmetry of a defect in a more direct manner than the diffuse scattering about any other point in reciprocal space. (auth)

48149 (COO-1488-13) EXPERIMENTAL AND THEORETICAL STUDIES OF MAGNETIC RESONANCE AND RELAXATION. Progress Report, September 1, 1967-August 15, 1968. (Kansas Univ., Lawrence). Contract AT(11-1)-1488. 22p. Dep. CFSTI.

Progress is reported on experimental projects in nuclear and electronic spin wave excitation and improvement of fast pulse techniques. Theoretical work on nuclear spin-wave relaxation, relation between spin-lattice relaxation and line width in the Orbach process, and calculation of magnetic resonance line width is reported. Variation of the product of electronic and nuclear spin wave relaxation rates in $RbMnF_3$ was measured as a function wave vector and temperature between 2.4 and 10.5°K. A minimum is found at a given wave vector which increases linearly with temperature. A broad band helix is being incorporated into the spectrometer for future high-power fast-pulse work employing a 1-kW traveling-wave tube currently on order. Theoretical treatment of nuclear spin wave relaxation rates shows them to be considerably less than expected on the basis of second moment of the Suhl-Nakamura interaction. In this way one explains the anomalously narrow NMR line width in $RbMnF_3$ and long lifetimes of nuclear spin waves as inferred from the parallel pumping data. Calculation of moments of the resonance line by random phase approximation (Tyablikov decoupling) appears to be totally inadequate for explaining line width in nickel near the Curie point. The line width of isolated paramagnetic ions has been derived for spin lattice interaction via the Orbach process. Observed discrepancy between line width and spin lattice relaxation rate can be accounted for by this calculation only if there is phonon bottlenecking. (auth)

48150 (INP-610) NEUTRON INVESTIGATION OF THE SPIN WAVE DISPERSION RELATION IN α-Co. Dimitrijevic, Zivan; Krasnicki, Szczesny; Todorovic, Jugoslav; Wanic, Adam (Institute of Nuclear Physics, Krakow (Poland)). May 1968, 27p. Dep.

The inelastic magnon scattering of monoenergetic (λ = 1.124 Å) neutrons on a single crystal of hexagonal cobalt was investigated. The Cracow Neutron Crystal Spectrometer, in the RA reactor in

Vinca was used and the neutron diffraction technique applied. For several missetting angles $\Delta\Theta$, the total widths 2Γ of scattered neutron cones which corresponded to scattering surfaces at a reciprocal lattice vector $\vec{\tau} = (00.2)$ were measured. The scanning was performed along two directions (horizontal and vertical) for $\Delta\Theta\epsilon[3.5°, 36°]$, hence it was possible to determine the acoustic magnon dispersion relation for [00.1] and [10.0] directions respectively for $q < 0.4\ q_{max}$ and $\hbar\omega < 35$ MeV. The results are compared with Low's theoretical predictions based on the Heisenberg-Dirac Hamiltonian. For the small wave vectors, no noticeable discrepancy between D constants ($D \approx 437$ MeV Å), which determine the dispersion relation of quadratic type, was observed. (auth)

48151 (IS-T-228) LOW TEMPERATURE SPECIFIC HEAT OF SOME CERIUM AND LANTHANUM LAVES PHASE COMPOUNDS. Joseph, Robert Roderick (Ames Lab., Iowa). May 1968. Contract W-7405-eng-82. 76p. Dep. CFSTI.

Thesis.

The low-temperature properties of the Laves phase compounds $CePt_2$, $CeRu_2$, $LaPt_2$, and $LaRu_2$ have been measured. Both of the ruthenium compounds have large values of γ and values of θ_D near those of the rare earth metal. The value of θ_D for $LaPt_2$ has been measured and found to be close to the θ_D for platinum. Also, θ_D for $CePt_2$ has been inferred, by comparing the specific heats to be not much smaller, if any, than that for $LaPt_2$. Thus it appears that for the ruthenium compounds it is the rare earth atoms which are giving the lattice its rigidity, i.e., rare earth-rare earth contacts, and in the case of the platinum compounds it is transition metals. The value r_A^{cal}/r_B for the platinum compounds is somewhat less than ideal, 1.208 versus 1.225. And as was described earlier, for radius ratios less than ideal, B atom contacts occur thus explaining why the platinum compounds have θ_D values more like the pure B atoms. In the case of the ruthenium compounds the radius ratios are 1.244 and 1.219 for lanthanum and cerium respectively. These values are about the same as the ideal or slightly larger thus making it plausible that in these compounds the elastic constants are controlled by A-A contacts in agreement with the specific data. To ascertain whether or not the behavior of the θ_D described above holds just for these compounds or is general for Laves phases, a table was prepared which lists θ_D for the Laves phases in comparison with θ_D for the pure components. It can be seen that in all cases, if r^{cal}/r_B is considerably less than theoretical, θ_D for the compound is closer to θ_D for the pure B element than for the A element. If r^{cal}/r_B is approximately equal or greater than ideal, θ_D for the compound is closer to θ_D for the A element. The agreement between the Debye temperature of $MgCu_2$ measured calorimetrically and by elastic constants gives some confidence that the calorimetrically determined Debye temperature is a measure of the forces holding the atoms together in these compounds. The fact that the γ values of the ruthenium compounds are large compared to $LaPt_2$ indicates that large band structure effects occur in these compounds which might serve to explain the order of the compounds. (D.L.C.)

48152 (N-68-23464) RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH-ENERGY ELECTRONS. Final Progress Report, March 15, 1967-March 15, 1968. Corelli, John C. (Rensselaer Polytechnic Inst., Troy, N. Y. [Dept.] of Nuclear Engineering and Science). 26p. (NASA-CR-66619). CFSTI.

Stress-induced dichroism studies of divalency-associated energy levels in irradiated silicon were conducted. A brief review of the experiments and the results obtained is included. An abstract is given of a paper dealing with the effects of 50-MeV electrons on the ultimate Fermi level in p-type germanium doped with gallium and indium and n-type germanium doped with antimony and arsenic. The ultimate Fermi level was found to be positioned closer to the valence band as a result of irradiation by particles capable of imparting a larger maximum recoil energy to the germanium atom. Infrared absorption studies of 45 to 50-MeV electron-irradiated heavily doped silicon were discontinued because of program termination. The research was to determine the impurity-associated radiation-induced defects by infrared spectroscopy measurements on silicon samples doped to relatively high concentrations with Bi, As, BO, and P. (STAR)

48153 (N-68-23481) OPTICAL ABSORPTION IN TRANSPARENT MATERIALS FOLLOWING HIGH-TEMPERATURE REACTOR IRRADIATION. Douglas, F. C.; Gagosz, R.; DeCrescente, M. A. (United Aircraft Corp., East Hartford, Conn.). May 1968. Contract NASw-847. 90p. (NASA-CR-1032; F-910485-2). CFSTI.

An experimental investigation was conducted to determine the optical absorption levels induced in fused silica as a result of exposure to nuclear-reactor irradiation over a range of fast-neutron fluxes, fast-neutron doses, and reactor temperatures. Also included in the investigation were a limited number of specimens made from alumina, hot-pressed beryllia, and single-crystal beryllia. Measurements of the ultraviolet transmittance spectrum were made prior to the reactor irradiation, after the reactor irradiation, and after a series of cobalt-60 gamma irradiations. Measurements were also made during and after heat treatments at elevated temperatures. The induced absorption coefficients were determined from these measurements at the centers of absorption bands located at 0.215 and 0.163 microns. (auth) (STAR)

48154 (N-68-24731) EFFECTS OF A HIGH-ENERGY PARTICLE ENVIRONMENT ON THE QUANTUM EFFICIENCY OF SPECTRALLY SELECTIVE PHOTOCATHODES FOR THE MIDDLE AND VACUUM ULTRAVIOLET. Heath, Donald F.; McElaney, James H. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1968. 15p. (NASA-TM-X-63215; X-622-68-180). CFSTI.

The quantum efficiencies of spectrally selective photocathodes for the middle and vacuum ultraviolet were measured. The photocathode materials investigated are semitransparent depositions of CsI, CuI, and CsTe on Al_2O_3 windows, and a solid tungsten photocathode located behind a MgF_2 window. The quantum efficiencies of these photocathodes were measured before their use as detectors in an Aerobee 150 rocket experiment, and again one year later. There was no observable change in their quantum efficiencies in this interval. These photodiodes were then irradiated with a dose of 5×10^{13} electrons/cm^2 at 1.0 MeV, and 5×10^{13} electrons/cm^2 at 2.0 MeV. This electron energy and dose represent what might be encountered in the artificial radiation belt in a circular, near-polar orbit at 1400 km in the course of a year. The quantum efficiencies of the photodiodes were again measured. Only the CsI photodiode showed a change, an increase by almost two and one-half times in its quantum efficiency. (auth) (STAR)

48155 (NYO-3464-12) THE M' AND R' CENTERS IN LiF: A COMPARATIVE STUDY OF ORBITAL DEGENERACY AND THE DYNAMIC JAHN-TELLER EFFECT IN OPTICAL SPECTRA. Report No. 993. Fetterman, Harold Ralph (Cornell Univ., Ithaca, N. Y. Materials Science Center). June 1968. Contract AT(30-1)-3464. 147p. Dep. CFSTI.

Thesis.

A comparative study of M' and R' centers in LiF, identified with the aid of uniaxial stress, was performed using both emission and absorption spectra. The effects of applied fields were investigated to determine the consequences of orbital degeneracy and the Jahn-Teller distortion. Analysis of the different spectra reveals several features which can be consistently interpreted in terms of a dynamic Jahn-Teller effect. (TSS) (auth)

48156 (UCB-34-P-20-2) POLARIZATION OF ^{19}F IN Tm^{2+}: CaF_2 IN OPTICAL PUMPING. Grant, W. B.; Ballard, R. L.; Mollenauer, L. F. (California Univ., Berkeley. Dept. of Physics). June 24, 1968. Contract AT(11-1)-34. 30p. Dep. CFSTI.

In a crystal of CaF_2 containing 0.05% Tm^{2+}, a significant enhancement of the ^{169}Tm nuclear polarization by optical pumping was achieved earlier. In this report, the method is extended to polarize the abundant ^{19}F nuclei by a three-spin cross-relaxation process involving a mutual flip of an ^{19}F nucleus and two polarized Tm^{2+} ions. Enhancements of 40 are observed for ^{19}F and explained by cross-relaxation theory. (auth)

48157 (UCRL-50439(Pt.2)) ON THE ANOMALOUS DIFFRACTION OF X RAYS THROUGH PERFECT CRYSTALS. Schroeder, R. C. (California Univ., Livermore. Lawrence Radiation Lab.). June 25, 1968. Contract W-7405-eng-48. 11p. Dep. CFSTI.

The theory of anomalous transmission is developed further by presenting von Laue's macroscopic derivation of the dispersion equations for diffraction in a crystal. The equation for the dispersion surface is developed and its relationship to the Ewald sphere is discussed. (auth)

48158 (UUIP-584) COHESIVE ENERGY AND ELASTIC CONSTANTS OF MgO WITH PARTIALLY SCALED WAVE FUNCTIONS. Calais, J. L.; Maekilae, K.; Mansikka, K.; Pettersson, G.; Vallin, J. (Uppsala Univ. (Sweden). Inst. of Physics). Apr. 1968. 13p. Dep.

The cohesive energy, the compressibility, and the elastic constants of MgO were calculated by an extension of Löwdin's method. The extension made the method valid for some deformation of the negative ions. (auth) (Sweden)

48159 (YALE-3219-19) PARAMAGNETIC AND ELECTRIC QUADRUPOLE HYPERFINE INTERACTIONS OF FERRIC IONS IN ICE AND $FeCl_3.6H_2O$. Nozik, Arthur J.; Kaplan, Morton

(Yale Univ., New Haven, Conn. Dept. of Chemistry). Apr. 1968. 25p. Dep. CFSTI.

Mössbauer resonance in ^{57}Fe has been used to study the species $Fe(H_2O)_5Cl^{2+}$ and $Fe(H_2O)_6^{3+}$ in frozen aqueous solutions of ferric chloride and ferric nitrate. The spectral lines display pronounced broadening as the temperature is lowered, as a result of paramagnetic relaxation effects. In dilute samples at 4.2°K, resolved paramagnetic hyperfine structure was observed for both species and permitted identification of the lowest crystal field states of the ferric ion. The effective magnetic fields originating from the $|\pm 5/2\rangle$ Kramers doublets were determined as 553 kG in $Fe(H_2O)_5Cl^{2+}$ and 588 kG in $Fe(H_2O)_6^{3+}$. The latter ion showed no evidence of an electric quadrupole interaction, whereas the former exhibited a significant quadrupole splitting due to the coordinated Cl^- ligand. The apparent electronic relaxation in the pentaquo-chloro complex was found to be substantially faster than that in the hexaquo complex, which may be indicative of a smaller zero-field splitting in the former case or an unbalanced spin-pairing in the Cl ion. Results are presented for crystalline $FeCl_3 \cdot 6H_2O$, in which the ion $Fe(H_2O)_4Cl_2^+$ exists as a structural unit. These spectra exhibit unusual line shapes and temperature variations which can be qualitatively understood by considering the effects of paramagnetic relaxation on the hyperfine interactions. The study of $FeCl_3 \cdot 6H_2O$ and its frozen solutions also demonstrates that common features as well as differences between the ion complex in solution and in the salt crystal may be inferred from a comparison of the Mössbauer spectra. (auth)

48160 ^{23}Na NUCLEAR MAGNETIC RESONANCE IN FERROELECTRIC ROCHELLE SALT. Oja, Tonis. Troy, N. Y., Rensselaer Polytechnic Inst., 1967. 127p.

Thesis.

It is shown that the ^{23}Na nuclear quadrupole resonance satellite lines in a single-crystal ferroelectric Rochelle salt can be used to investigate the temperature dependence of the spontaneous polarization and the effects of externally applied electric fields and γ radiation on the spontaneous polarization. Polarization was measured with the crystal z-axis accurately perpendicular to the magnetic field. On going from either of the orthorhombic nonpolar phases into the polar phase ($-18°C < T < +24°C$) the satellite line under investigation split into a pair of satellites owing to the lowering of the symmetry. The satellite line separation in frequency as a function of temperature was found to be proportional to the polarization as measured by the Sawyer–Tower bridge method. Radiation damage decreased the satellite-line separation and hence the polarization, indicating that the defects introduced into the crystal have strong effects on the structure of the ferroelectric phase. When 3% of the unit cells were damaged the polarization had decreased by 20%. Polarization continued to decrease for two weeks after cessation of radiation. When the crystal z-axis is tilted slightly away from perpendicularity with the magnetic field, every satellite in the ferroelectric phase was observed to split further into a pair of satellites. By applying an increasing external electric field, one satellite of the pair began to decrease in amplitude while the other increased until at a given field only one of the pair remained. On decreasing the field, this process does not reverse but instead a hysteresis loop is traced out. A hysteresis loop obtained in this manner took 10 to 12 hours to complete and is called a "quasi-static" hysteresis loop. Light radiation damage caused the quasi-static hysteresis loops to collapse at the center, whereas hysteresis loops obtained by the Sawyer–Tower bridge method begin to collapse at considerably higher doses of radiation. The above results, together with the results of a transient NMR experiment used to investigate the dynamics of polarization reversal, confirm that there are two different mechanisms of polarization reversal in ferroelectric Rochelle salt. (TSS) (Disser. Abstr.)

48161 MAGNETIC PROPERTIES OF SINGLE CRYSTALS OF UTe_2 AND UTe_3. Pechennikov, A. V.; Chechernikov, V. I.; Barykin, M. E.; Ellert, G. V.; Slovyanskikh, V. K.; Yarembash, E. I. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 4: 1342-3(Aug. 1968). (In Russian).

The magnetic properties of UTe_2 and UTe_3 monocrystals and polycrystals were studied. The curves of magnetic properties of UTe_2 and UTe_3 specimens as functions of the temperature are given. It was postulated that at temperatures below 77°K UTe_2 and UTe_3 exhibit antiferromagnetic behavior. The magnetic properties were measured only in the directions perpendicular and along the c axis; at H⊥c, magnetic susceptibility is much higher than at H||c. The data obtained show that magnetic properties of UTe_2 and UTe_3 are due to the 5f and 6d electrons. (R.V.J.)

48162 MAGNETIC CHARACTERISTICS OF LANTHANIDE–ALUMINUM COMPOUNDS. Mader, K. H.; Wallace, W. E. (Univ. of Pittsburgh). J. Less-Common Metals, 16: 85-90(Oct. 1968).

Susceptibilities (χ) for α–Ce_3Al (hexagonal) are presented for the temperature range 4° to 870°K, and for β–Ce_3Al (cubic), Pr_3Al, Pr_2Al and $PrAl_4$, for the temperature range 4° to 300°K. These data together with previously published results provide magnetic information for all known Ce–Al and Pr–Al compounds. Magnetization vs. field results are also presented for these five compounds for 4°, 77° and 300°K. Both forms of Ce_3Al remain paramagnetic to the lowest measured temperatures. Pr_3Al and Pr_2Al are ferromagnetic and antiferromagnetic, respectively, with magnetic ordering temperatures 16° and 18°K, respectively. $PrAl_4$ behaves anomalously; it may be ferrimagnetic below 12°K. Curie–Weiss behavior is observed for temperatures in excess of 100°K. Effective moments deduced from the temperature dependence of susceptibility are in close agreement with $g\sqrt{J(J+1)}$, the value expected for the free tripositive ion. Deviations from Curie–Weiss behavior are noted at low temperatures, originating presumably with the crystal field interaction. The six known Pr–Al series of compounds show oscillation between ferromagnetic and antiferromagnetic coupling. This is ascribed to the varying electron concentration throughout the series. In keeping with earlier observations the coupling mode for the Pr–Al series seems essentially unaffected by the crystal structure of the compound. (auth)

48163 COLOR CENTER FORMATION IN KI AND NaCl CRYSTALS BY THE IRRADIATION OF AN ELECTRON BEAM PULSE. Ueta, Masayasu (Argonne National Lab., Ill.). Sci. Rep. Tohoku Univ., First Ser., 50: 236-41(Dec. 1967).

Transient optical transmission change of alkali halide crystals was measured photoelectrically in the spectral region from 240 to 1100 mμ. A 13.5-MeV electron beam from a linear accelerator irradiated the crystals uniformly over a circular area of 1 cm^2. With KI crystals the transmission of light was shown to reach a minimum at the end of the electron pulse, with a rapid increase within about 3 μsec and subsequent slow increase. From the minimum transmission of the crystal the optical density D at time $t = 0$, $D_{\lambda,t=0}$ was calculated. Similar measurements were carried out at every 10-mμ wavelength interval from 240 to 1100 mμ. By plotting $D_{\lambda,t=0}$ as a function of wavelength λ, the transient absorption spectrum $t = 0$ is obtained. When the optical density of the absorption band at 445 mμ was plotted as a function of time t, after the end of the electron pulse, in semilog scale, the curve was shown to be resolved into 2 straight lines, indicating first-order decay kinetics. The absorption of the KI crystal at 445 mμ is considered to consist of 2 bands, 1 with a short, 1.2 μsec, and another with long life times. By extrapolating these 2 lines to $t = 0$, the optical densities of 2 bands at $t = 0$ was obtained as 0.067 and 0.048, respectively. The optical density of the crystal at 445 mμ is 0.115 at $t = 0$; therefore, the contributions of these components to the total optical density at 445 mμ are 56 and 42%, respectively. From the measurements of the contributions of these component bands at each wavelength region, the absorption spectrum at $t = 0$ could be resolved into the known H, V_1, V_2, and V_3 bands corresponding to the low temperature hole centers. A fraction of the F and F′ bands decayed with the same time constant as that of the hole band, indicating the recombination annihilation of hole with electron centers. (BBB)

48164 ^{57}Co MOESSBAUER SOURCE IN PALLADIUM. Dobrev, D.; Tomov, T.; Ruskov, T.; Lefterov, D. (Inst. of Physical Chemistry, Sofia). Prib. Tekh. Eksp., No. 5, 235-7(Sept.-Oct. 1967). (In Russian).

The technique of preparing a ^{57}Co Moessbauer source introduced into the lattice of palladium is described. The method of electrodepositing ^{57}Co onto a palladium foil and also introducing it into a palladium matrix is indicated. The line width referred to zero thickness of the $Na_2[Fe(CN)_5NO] \cdot 2H_2O$ absorbent is 10% greater than the natural width. The Debye-Waller factor (equal to 0.8) is calculated from the Moessbauer spectra obtained from different thickness of absorbent. (auth)

48165 ELECTRONIC STATE OF Yb IN SOME α–Pd–Yb ALLOYS. Speight, J. D.; Harris, I. R.; Raynor, G. V. (Univ. of Birmingham, Eng.). J. Less-Common Metals, 16: 164-5 (Oct. 1968).

The lattice spacings at 22°C of some Pd–Yb solid solution alloys annealed at, and rapidly cooled from, 900°C are plotted against composition. The spacings for the alloys increase uniformly up to a solid-solubility limit for Yb in αPd of approximately 16.5 at. % at 900°C. At higher Yb contents, two phases were present. At 25 at. % Yb only the diffraction pattern for the $YbPd_3$ phase was observed. The observation that the lattice spacing for the $YbPd_3$ phase falls on the extrapolation of the linear variation of the solid solution alloys confirms that the Yb atoms are in the 3-valent state in the solid solution alloys as well as in $YbPd_3$. (A.G.W.)

48166 NUCLEAR MAGNETIC RESONANCE AND SUSCEPTIBILITY OF EQUIATOMIC RARE EARTH–ALUMINUM COM-

POUNDS. van Diepen, A. M.; de Wijn, H. W.; Buschow, K. H. J. (Univ., Amsterdam. Philips Research Labs., Eindhoven, Netherlands). Phys. Status Solidi, 29: 189-92(Sept. 1, 1968).

The Knight shift of the NMR of ^{27}Al and the susceptibilities of the compounds LaAl, GdAl, TbAl, DyAl, HoAl, and ErAl have been measured as a function of temperature. The results are discussed in terms of the Ruderman–Kittel–Kasuya–Yosida theory. The exchange integral Γ between conduction electrons and 4f electrons is found to be −0.39 eV. (auth)

48167 TRANSIENT EFFECTS IN THE ROOM-TEMPERATURE F-COLOURING OF NaCl IRRADIATED WITH X OR γ RAYS. Sanchez, C.; Agulio-Lopez, F. (Junta de Energia Nuclear, Madrid). Phys. Status Solidi, 29: 217-30(Sept. 1, 1968).

A new transient effect in the room-temperature F-coloring of NaCl is presented which occurs whenever an x- or γ-irradiation is resumed after an interruption time wherein the crystal remains in the dark. A detailed study of the characteristics of the effect is made and a relatively simple theoretical model is proposed to account for them. Essentially, the model is based on the existence of a thermally activated process consisting of the removal of free anion vacancies. The data on transient coloring permit one to investigate the kinetics of that vacancy process and determine its activation energy (0.39 eV). (auth)

48168 INVESTIGATION OF THE MAGNETIC AFTEREFFECT IN NICKEL AFTER NEUTRON IRRADIATION AND PLASTIC DEFORMATION. Walz, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi, 29: 245-58(Sept. 1, 1968). (In German).

The magnetic aftereffect of Ni single crystals after neutron irradiation and plastic deformation is investigated in detail in the temperature range between −180 and +150°C. Major relaxation peaks are discovered at −128, −100, −80, −38, and −21°C which can be attributed to single relaxation processes. Between 0 and +150°C, the aftereffect is found to have less structure, showing only one broad peak at about +50°C. In accordance with measurements of the coercitive force and recovery experiments, the observed spectrum of relaxation processes can be ascribed to the reorientation of different anisotropic clusters of point defects, some of them possibly involving impurities. (auth)

48169 STUDY OF AGGLOMERATED DEFECTS IN IRRADIATED PURE NICKEL BY ELECTRON MICROSCOPY. Bourret, A.; Dautreppe, D. (CEN, Grenoble, France). Phys. Status Solidi, 29: 283-98(Sept. 1, 1968).

When pure nickel foils are neutron- and electron-irradiated, black dots are observed by electron microscopy. After neutron irradiation at 77°K and subsequent annealing at room temperature, the larger dots are found to be interstitial Frank dislocation loops. The smaller ones (<15 Å) are vacancy agglomerates in the form of tetrahedral voids. Investigation of dose dependence and further annealing is also presented. After electron irradiation at 10°C, only interstitial Frank dislocation loops are visible for doses larger than 4×10^{19} electrons/cm^2 at 2 MeV. Discussion of nucleation and agglomeration of free interstitials is presented, showing that the elastic interaction between loops plays an important role. (auth)

48170 LATTICE DYNAMICS OF HEXAGONAL STRUCTURE METALS. Czachor, A. (Inst. of Nuclear Research, Swierk, Poland). Phys. Status Solidi, 29: 423-34(Sept. 1, 1968).

The lattice dynamics of the hexagonal close-packed structure (hcp) metals Mg, Zn, and Be are investigated assuming various first principles interionic interaction potentials. It is found that, if the ions interact via a Thomas–Fermi potential, the Huang condition for the vanishing of the anisotropic stresses is not fulfilled, but only when assuming a c/a ratio corresponding to the ideal hcp structure. One can accept the same for Coulomb and Bardeen potentials, too. None of the potentials used gives a satisfactory deacription of the phonon dispersion relations for the mentioned metals. The need for introducing a non-radially symmetric effective interaction potential is discussed. It is observed that, for the transverse phonon branches Δ_3 and Δ_4, the Coulomb interaction between the ions leads to better agreement with experiment than any of the screened Coulomb interactions investigated. The numerical calculations of the lattice sums are carried out with the help of a convergence procedure based on elementary functions. (auth)

48171 GALVANOMAGNETIC EFFECT IN FERROMAGNETIC ALLOYS OF NICKEL–TANTALUM AND NICKEL–NIOBIUM SYSTEMS. Alizade, Z. I.; Magarramov, T. G. (Azerbaidzhan Polytechnical Inst., Baku). Phys. Status Solidi, 29: K19-22(Sept. 1, 1968).

An equation correlating the galvanomagnetic effect with the magnetization in the paraprocess region is $-\Delta\rho/\rho_M = B(I^2 - \vec{I}^2)/(I_{s_0}^2 - \vec{I}^2)$. The equation was checked by measurements on Ni alloys containing 0.7, 1.3, and 2.0 at. % Ta or 1.3, 2.5, and 3.8 at. % Nb. The magnetic resistivity (ρ_M) was found to be directly proportional to the squared spontaneous magnetization (I_s^2) and inversely proportional to the concentration of the non-ferromagnetic element. A graph of $-\Delta\rho/\rho_M$ vs $(I^2 - \vec{I}^2)/(I_{s_0}^2 - \vec{I}^2)$ for all the alloys confirm the equation, and the slope gives B = 0.5. (D.L.C.)

48172 THE ELECTRON STRUCTURE OF Sc AND MECHANISM OF THE KNIGHT SHIFT IN $ScAl_2$ AND $ScAl_3$. Chechernikov, V. I.; Nedel'ko, V. I.; Vedyaev, A. V. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 55: 486-9(Aug. 1968). (In Russian).

Data on the distribution of the spin density in metallic Sc are obtained on basis of experimental data on the magnetic susceptibility of Sc in the $ScAl_2$ and $ScAl_3$ compounds. It is shown that the anisotropy of the electron cloud which is drawn out along the hexagonal axis, is defined by the diamagnetic susceptibility. An important role in the production of fields on aluminium nuclei is played by collectivized Sc d electrons, the effect of which depends on the structure of the compounds. (auth)

48173 RELAXATION PROCESS DUE TO LONG-RANGE DIFFUSION OF HYDROGEN AND DEUTERIUM IN NIOBIUM. Schaumann, G.; Voelkl, J.; Alefeld, G. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev. Lett., 21: 891-3(Sept. 23, 1968).

A new method was used for the determination of diffusion coefficients to hydrogen and deuterium in niobium. The activation energies for both isotopes are comparatively small and differ by about 20%, whereas D_0 is the same within experimental error. The activation energy for hydrogen diffusion is equal to the energy difference $\hbar\omega_H = 114 \pm 6$ MeV between the ground state and the first excited state of the hydrogen atom in solution. (auth)

48174 SPATIAL DISTRIBUTION OF TRAPPED ELECTRONS IN GAMMA-IRRADIATED ORGANIC GLASSES. Kevan, Larry; Chen, D. H. (Univ. of Kansas, Lawrence). J. Chem. Phys., 49: 1970-1(Aug. 15, 1968). (COO–1528-24).

EPR measurements were used to study the size of the spatial inhomogeneities associated with trapped electrons in γ-irradiated methanol and methyltetrahydrofuran (MTHF) organic glasses of differing polarity. $(T_1T_2)^{\frac{1}{2}}$ and, when possible, T_2 were determined from power-saturation curves (T_1 is spin–lattice relaxation time and T_2 is spin–spin relaxation time). The most significant result was that T_1T_2 remained constant over a given dose range for each material. This suggests that the spins are trapped in radiation-produced regions of inhomogeneity called spurs. Comparison of the results with previous results on alkaline ices leads to the conclusion that the size of the spatial inhomogeneities associated with radiation-produced trapped electrons increases with decreasing polarity of the matrix. (A.G.W.)

48175 ZEEMAN STUDIES ON Er^{3+} IN $GdCl_3$. Randazzo, Donald J. (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 49: 1808-14(Aug. 15, 1968).

The absorption spectrum of Er^{3+} in $GdCl_3$ has been investigated. Extensive Zeeman series have been obtained for three different groups of states with fields applied parallel to the hexagonal axis. It is found that the Zeeman splittings of the Er^{3+} states depend on the magnetic ordering of the $GdCl_3$ host, and this must be considered in order to get correct Zeeman factors for these states. An attempt was made to represent the effect of the magnetic ordering on the states by a term proportional to the crystal magnetization. A theoretical expression is given for the magnetization of $GdCl_3$ under the different conditions of temperature and field used in the experiments. The Er^{3+} Zeeman factors obtained with the model are seen to be consistent at all field intensities and to be in reasonable agreement with what one obtains from calculations using the crystal-field parameters of Er^{3+} in $GdCl_3$. (auth)

48176 MAGNETIC CHARACTERISTICS OF EUROPIUM–ALUMINUM INTERMETALLICS. Mader, K. H.; Wallace, W. E. (Univ. of Pittsburgh). J. Chem. Phys., 49: 1521-6(Aug. 15, 1968).

Bulk magnetic characteristics of $EuAl_2$ and $EuAl_4$ are reported for temperatures ranging from 4 to 300°K and for field strengths up to 20 kOe. To evaluate the influence of electron concentration on the magnetic interactions a series of $Eu_xLa_{1-x}Al_2$ alloys, with x ranging from 0.1 to 0.8, was studied over the same interval of temperature and field strength. Between 50 and 300°K all samples exhibited Curie–Weiss behavior with an effective moment characteristic of dipositive europium. $EuAl_4$, $EuAl_2$, and $Eu_{0.8}La_{0.2}Al_2$ become antiferromagnetic below 20°K, two types of antiferromagnetic order being indicated for the latter two intermetallics. Increasing the electron concentration by replacing Eu with tripositive La alters the interaction from predominantly antiferromagnetic to predominantly ferromagnetic as the electron concentration approaches 9. The change in sign of the interaction occurs at about 8.4 electrons per magnetic atom. $Eu_{0.1}La_{0.9}Al_2$ and

$Eu_{0.2}La_{0.8}Al_2$ are ferromagnetic at 4°K with Eu moments of about 5 μ_B per formula unit. Eigenvalues of the spin Hamiltonian are obtained for Eu^{2+} in a site of tetragonal symmetry and used to interpret the saturation moments observed for the ferromagnetic ternaries and the deviations from Curie–Weiss behavior for $EuAl_2$ and the (Eu,La)Al_2 alloys. The bulk magnetic properties can be quite successfully accounted for on the basis of an overall (Zeeman-like) splitting of 480°K. (auth)

48177 MAGNETIC SUSCEPTIBILITIES OF NONSTOICHIOMETRIC $UO_{2+x} \cdot yThO_2$ SYSTEM. Goto, Kunihiro (Central Research Lab., Tokyo). J. Inorg. Nucl. Chem., 30: 2101-9(Sept. 1968).

The magnetic susceptibilities of the system $UO_{2+x} \cdot yThO_2$ were investigated with respect to the average uranium valency (or x) as well as the atomic ratio U/(U + Th) (or y). The magnetic properties of this system are characterized by their temperature independent paramagnetic term, in contrast to the $UO_2 \cdot yThO_2$ solid solution which simply obeys the Curie–Weiss law. The Weiss constant of the former system scarcely changes with uranium concentration. The effective magnetic moment of this system can be estimated from the mean uranium valency, almost independently of the atomic ratio U/(U + Th). When the effective magnetic moment was plotted vs the mean uranium valency, a discontinuity was observed at the valency of about 4.7 in every case. The results obtained from the extremely diluted sample apparently suggest that the uranium ions in this sample consisted of a mixture of U(IV) and U(VI) species, but definite conclusions concerning the valency of other samples have not yet been obtained. (auth) (UK)

48178 A SIMPLE TRANSPARENCY MODEL FOR THE CHANNELING OF LOW-ENERGY LIGHT IONS IN CRYSTALS. Andreen, C. J. (Chalmers Univ. of Technology, Goteborg). Ark. Fys., 35: 363-81(1968).

The degree of correlation between relative channeled intensities and channel areas was studied for D^+ ions of energies around 15 keV, transmitted through thin single crystal gold films in the forward direction. It was found that for film thicknesses around 200 to 400 Å a linear relationship exists between the two entities. In the (111) planes, the degree of correlation is close to 100%. Planar channeling along (111) and (100) planes play an important role in obtaining the linear relationship. (Sweden)

48179 EXPERIMENTS ON THE TRANSMISSION OF LOW-ENERGY LIGHT IONS THROUGH THIN FILMS OF DIFFERENT STRUCTURES. Andreen, C. J. (Chalmers Univ. of Technology, Goteborg). Ark. Fys., 35: 583-93(1968).

Transmitted intensities of D^+ ions through polycrystalline, textured and single crystal films of gold are shown as functions of the polar angle Θ and the azimuthal angle ϕ. Silver, alpha-iron, and mica were also used. In one case the most probable energy loss $\Delta E_{mp}\Theta$ is shown. It was found that governed motion exists in films which are not single crystals. It was shown that a gold lattice may grow on top of a silver lattice in such a way that the gold atoms occupy normal silver lattice sites. A semiconductor doping technique is suggested, based upon a precanalisation of the ions. (Sweden)

48180 THERMAL CONDUCTIVITIES AND LORENZ FUNCTIONS OF Dy, Er, AND Lu SINGLE CRYSTALS. Boys, D. W.; Legvold, S. (Ames Lab., Iowa). Phys. Rev., 174: 377-84 (Oct. 10, 1968). (IS–1793).

The thermal conductivity and electrical resistivity of Dy, Er, and Lu single crystals have been measured from 5 to 300°K. The Lorenz functions were calculated from the experimental results, and they exceeded the value expected for pure electron heat conduction. This indicated that phonons and/or magnons must contribute significantly to the heat conduction. At high temperatures, the thermal conductivity was separated into suggested electron and phonon contributions. The magnetic transitions in Dy and Er produced an anisotropic effect on the thermal conductivity which is interpreted on the basis of magnetic superzones. A high-temperature anisotropy is explained by the anisotropic shape of the Fermi surface. (auth)

48181 TEMPERATURE-DEPENDENT ISOMER SHIFT AND ANHARMONIC BINDING OF ^{119}Sn IN Nb_3Sn FROM MOESSBAUER-EFFECT MEASUREMENTS. Shier, J. S.; Taylor, R. D. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Rev., 174: 346-50(Oct. 10, 1968). (LA-DC-9102).

The temperature dependence of the Moessbauer recoil-free fraction and the line shift of ^{119}Sn were studied in several Nb_3Sn absorbers between 4 and 375°K. The recoil-free fraction measurements show that the forces on the tin atoms are highly anharmonic. The line-shift measurements are interpreted in terms of a temperature-dependent electron density at the tin nucleus, which is shown to support previous suggestions of a very narrow d band near the Fermi level. (auth)

48182 MASS DEPENDENCE OF THE ANGULAR DISTRIBUTION OF CHARGED-PARTICLE EMISSION FROM CRYSTALS: TRANSITION TO THE CLASSICAL LIMIT. De Wames, R. E.; Hall, W. F.; Lehman, G. W. (North American Rockwell Corp., Thousand Oaks, Calif.). Phys. Rev., 174: 392-9(Oct. 10, 1968).

In recent years, the emission of charged particles from crystals has received considerable attention, both experimentally and theoretically. The customary interpretation of the emission patterns has been derived from classical mechanics, which predicts patterns very close to those observed for heavy charged particles (protons, α particles) but only qualitatively similar to those exhibited by electrons and positrons. It is shown that at least one consequence of the classical model, namely, mass independence of the angular distribution at constant energy, is violated dramatically by the quantum-mechanical calculation of the emission pattern. Specifically, the emission patterns for electrons and positrons are shown to differ from the emission patterns for much-higher-mass particles by factors of up to 4 in half-width and intensity. The condition under which the classical limit is regained is that the lattice spacing be large, not compared with the particle de Broglie wavelength, but compared, rather, with $\lambda_p = \hbar/2(m\bar{V})^{\frac{1}{2}}$, where $\bar{V}$ is an average value for the interaction potential inside the unit cell, and m is the particle mass. (auth)

48183 MULTIPHONON ORBIT-LATTICE RELAXATION OF EXCITED STATES OF RARE-EARTH IONS IN CRYSTALS. Riseberg, L. A.; Moos, H. W. (Johns Hopkins Univ., Baltimore). Phys. Rev., 174: 429-38(Oct. 10, 1968).

A systematic study has been made of multiphonon orbit-lattice relaxation of excited states of rare-earth ions in crystals. By measuring both excited-state fluorescence lifetimes and multiphonon relaxation quantum efficiencies, pure multiphonon transition rates were determined for the following set of crystals: (1) $LaBr_3:Nd^{3+}$, $LaBr_3:Dy^{3+}$, and $LaBr_3:Ho^{3+}$; (2) $LaF_3:Er^{3+}$ and $LaF_3:Ho^{3+}$; (3) $SrF_2:Ho^{3+}$ and $SrF_2:Er^{3+}$; and (4) $Y_2O_3:Er^{3+}$ and $Y_2O_3:Ho^{3+}$. Lifetimes were measured both in the near infrared using the fluorescence phase-shift technique, and in the visible region using pulse-excitation techniques. Measurements were performed at 4.2°K to determine spontaneous multiphonon transition rates, as well as at higher temperatures. The temperature dependences were fitted with a theoretical model involving the stimulated emission of phonons due to the thermally populated phonon modes. These results indicate that the decay involves the emission of high-energy optical phonons and occurs in approximately the lowest order permitted by energy conservation and cutoff in the phonon spectrum. The spontaneous transition rate was found to have a systematic exponential dependence on the transition energy to the terminal level, that is, on the energy gap. This behavior is interpreted as being due to the simple convergence of the orbit-lattice perturbation expansion. With the precise features of the interacting phonon modes and atomic levels averaged out for these high-order processes, the only critical parameter within a given lattice is the energy gap, i.e., the order of the process. The dependence on the order has been extracted by normalizing the energy gap by the optical-phonon cutoff energy. The rate for a given order and the swiftness of the convergence reflect the strength of the orbit-lattice interaction. The relative behavior for a given host can be explained through its known crystalline properties, in particular the phonon frequency distribution function and the static crystal field. The observed order dependence in Y_2O_3 indicates a relative weakness in the orbit-lattice interaction for crystals with strong covalency. (auth)

48184 ELASTIC MODULI AND ULTRASONIC ATTENUATION OF GADOLINIUM, TERBIUM, DYSPROSIUM, HOLMIUM, AND ERBIUM FROM 4.2 TO 300°K. Rosen, M. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). Phys. Rev., 174: 504-14 (Oct. 10, 1968).

The longitudinal and transverse acoustic velocities and the ultrasonic attenuations in high-purity polycrystalline gadolinium, terbium, dysprosium, holmium, and erbium metals have been measured by a pulse technique at a frequency of 10 MHz between 4.2 and 300°K. The variations with temperature of the Young moduli E, shear moduli G, adiabatic compressibilities K_s, and Debye temperatures Θ_D have been determined. The anomalies observed in the elastic and anelastic behavior were correlated with the magnetic transitions known to occur in these metals. The behavior of the elastic properties and ultrasonic attenuations in the vicinity of the majority of the magnetic transition points was in accord with the criteria of Landau et al.'s theories of second-order phase changes. Exceptions are the ferromagnetic

transitions in terbium and dysprosium, and the change in the antiferromagnetic structure of erbium at 56°K. The character of the elasticity anomalies in these three cases tends to indicate that they are of first order. The abrupt change in the easy direction of magnetization in gadolinium at 224°K is sharply manifested in the elastic and anelastic properties. Determination of these properties in holmium revealed an anomalous behavior at 70°K. The temperature variation of the Debye temperatures in gadolinium, terbium, dysprosium, holmium, and erbium depicts the elasticity behavior. The limiting Debye temperatures at 0°K are, in general, higher than those obtained from specific-heat measurements. (auth)

48185 MAGNETIC STRUCTURE PROPERTIES OF ALLOYS OF Tb, Ho, AND Er WITH Sc. Child, H. R.; Koehler, W. C. (Oak Ridge National Lab., Tenn.). Phys. Rev., 174: 562-4 (Oct. 10, 1968).

Powder neutron diffraction patterns were obtained from binary solid solution alloys of the rare-earth elements Tb, Ho, and Er with Sc at temperatures ranging from room temperature to 1.3°K. Dilution by Sc stabilizes the oscillatory magnetic structures of the rare earths at the expense of any ferromagnetic component that may be present. In contrast to the case for alloys with yttrium, the transition temperature of the Sc-based alloys cannot be represented by a universal function of the effective-spin variable $x = c(g-1)^2 J(J+1)$. Instead, the transition temperatures follow different but similar curves for each series; T_N goes below 1.3°K at atomic concentrations of about 25 at. % Tb, 18 at. % Ho, and 39 at. % Er. The lack of magnetic ordering in such relatively concentrated alloys indicates that the magnetic interaction in the pure elements has been drastically modified by the dilution with scandium. (auth)

48186 EFFECT OF BACKING ON ENHANCEMENT OF γ-EXCITED FLUORESCENCE X RAYS. Kaminishi, Tokishi (Government Industry Research Inst., Nagoya, Japan). Oyo Butsuri, 37: 725-32(Aug. 1968). (In Japanese).

In a previous report it was shown that the conversion yield of fluorescence x rays for high-energy γ rays is enhanced by scattering γ rays within a target. In order to establish the enhancement factor of fluorescence x rays due to scattering γ rays, an experiment was performed with a Cs-137 source for several sets of a target and a backing that acts as a scattering source. It was found that the enhancement factor increases with backing thickness with the same dependency as the reflection coefficient of incident γ rays does with scatterer thickness. Calculations were made for the yield of Pb X_K excited by the scattering γ rays in a backing by a few approximate methods. Calculated values were about 30% less than those observed. The difference may be mainly due to the excitation processes of multiple scattering γ rays within the target and of secondary electrons. (auth) (NSA of Japan)

48187 CONVERSION YIELD OF γ-EXCITED FLUORESCENCE X RAYS. Kaminishi, Tokishi (Government Industry Research Inst., Nagoya, Japan). Oyo Butsuri, 37: 702-10(Aug. 1968). (In Japanese).

In order to estimate the quantity of fluorescence x rays from a specimen irradiated with high-energy γ rays, the conversion yield of fluorescence x rays was measured for plane targets and a beam of γ rays from a Cs-137 source. Several procedures were followed to determine the absolute yield experimentally. The angular distribution of the yield and the intensity ratio of fluorescence x rays to scattering γ rays emerging from a lead target were also measured, as well as the variation of the yield with target thickness. It was shown that the backward yield finally saturates at a thickness corresponding to a few mean free paths of backscattering γ rays, not of fluorescence x rays. From this result the enhancement of the yield is considered to be mainly due to excitation by the scattered γ rays within the target. Calculations of the yield were made for excitation by incident γ rays and by singly scattered γ rays in the target. The approximate calculation roughly coincided with the experiment, but complete agreement was not obtained even after the inclusion of the enhancement effect of secondary electrons. It seems to be necessary to take excitation by multiple scattering γ rays into account in the yield calculation. (auth) (NSA of Japan)

48188 FERMI SURFACE AND CORRELATION EFFECTS IN OPTICAL PROPERTIES OF MOLYBDENUM. Bolotin, G. A.; Maevskii, V. M.; Charikov, B. A. (Inst. of the Physics of Metals, Moscow). Fiz. Metal. Metalloved., 25: 629-36(1968). (In Russian).

Measurements of optical properties in the infrared region were performed on molybdenum in order to determine the value of the electron plasma frequency. A comparison was made between this value and that calculated from the Sparlin–Marcus model (Phys. Rev., 144: 484(1966)) for the Fermi surface of molybdenum. The purpose was to determine the extent of correlation interaction in molybdenum. The Fermi surface of molybdenum is shown, and the dimensions of the various segments are given. An equation is given for determining the area of the Fermi surface, and relations are derived from it for the square of the plasma frequency and the density of states. Using a gas approximation, the square of the plasma frequency calculated from the Sparlin–Marcus model was found to be greater than 1.38×10^{32} sec^{-2}. Optical measurements were performed on molybdenum sheet in the range 2.5 to 20 mk at room temperature, using the polarimetric method. The relationships among the dielectric permeability, square of the plasma frequency, and the relaxation frequency are given. Experimental values of the square of the plasma frequency were found to be 40% lower than those calculated from the Sparlin–Marcus model. The difference was caused by a correlation effect, and the correlation parameter (A) for the equation $\Omega^2 = \Omega_0^2(1 + A)$ was calculated to be –0.4. In this equation Ω is the plasma frequency and Ω_0 is the plasma frequency determined from the law of scattering. (ATD)

48189 THERMAL RELEASE OF INERT GASES FROM A (100) TUNGSTEN SURFACE. Kornelsen, E. V.; Sinha, M. K. (National Research Council, Ottawa). J. Appl. Phys., 39: 4546-55(Sept. 1968).

A clean (100) tungsten surface was bombarded with beams of 40-eV to 5-keV ions of Ne, Ar, Kr, and Xe. Gas desorption rates, measured as the crystal was subsequently heated at 40°K/sec, show a number of fairly clearly defined peaks between 400 and 2200°K. The characteristics of these peaks with varying ion energy, mass, and direction of incidence suggest the following interpretation: (a) All peaks below 1650°K (4 for Ne, 5 for Ar, Kr, and Xe) are the result of desorption via a single activated step from sites within, at most, 10 Å of the crystal surface, and (b) the single peak above 1700°K is the result of isotropic diffusion of more deeply penetrating ions with an activation energy 104 kcal/mole, the same for all four gases. (auth)

48190 SMALL-ANGLE SCATTERING OF X RAYS BY NEUTRON-IRRADIATED GERMANIUM. den Ouden, G. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. J. Appl. Phys., 39: 4509-17(Sept. 1968). (COO-1198-523).

A study was made of neutron-irradiated germanium single crystals by measuring the small-angle scattering of x rays. The magnitude of the observed scattering is found to be strongly dependent on the crystallographic orientation of the specimen with respect to the direction of the incident x-ray beam. The scattering can be explained in terms of double-Bragg scattering and is believed to be due to lattice strain associated with the radiation-induced defects. The results imply that the damaged regions (spikes) which in addition to point defects are produced by the bombarding neutrons have a disordered (possibly amorphous) structure with a density which differs from that of the surrounding matrix by at most a few percent. Annealing measurements reveal a distinct annealing stage centered at about 160°C in which approximately 60% of the small-angle scattering recovers. The activation energy of this stage is found to be 1.2 eV and is associated with the annihilation of either vacancies or divacancies. The annealing of the remainder of the small-angle scattering in the temperature range above 350°C is attributed to the recovery of the damaged regions. (auth)

48191 NONTHERMOLUMINESCENT SMOKY COLOR CENTER IN γ-IRRADIATED α QUARTZ. Lee, Hee Yong (AERI, Seoul). J. Appl. Phys., 39: 4850-1(Sept. 1968).

A thermoluminescence technique was used to study non-T. L. (no luminescence) smoky color centers in γ-irradiated radiation-resistive α quartz (type 2). Coloration patterns of type-2 samples show crystal imperfections including twin boundaries. Activation analyses show that a lighter region has a higher content of Al and Na impurities than a darker region. Since the T. L. smoky color center has a larger capture cross section for a hole, it probably is the $^{Al}A_+$ defect, while the non-T. L. center is the ^{Al}A defect. (D.L.C.)

48192 ON THE POSSIBLE MECHANISM OF X-RAY COLORATION IN KCl(Ca) CRYSTALS. Voszka, R.; Horvath, T.; Watterich, A. (Research Lab. for Crystal Physics, Budapest). Acta Phys. Acad. Sci. Hung., 24: 255-66(1968).

It is established that in KCl(Ca) crystals grown OH-free, and x-irradiated in the temperature interval between –80°C and room temperature, the less-stable V_K^M band is observable beside the stable V_2^M band in the first so-called fast stage of coloration. (The superscript M referring to the divalent metal impurity serves to distinguish the bands from the corresponding V_2 and V_K bands of pure crystals.) The positions of the band maxima, measured at –180°C are 222 and 323 nm, respectively. The V_K^M centers may be transformed spontaneously into V_2^M centers, so they can be con-

sidered to be "pre-centers" of V_2^M centers. The opposite process can also be brought about by illumination with white light. If the crystal, x-irradiated at room temperature (RT) is illuminated at –180°C with white light, the transformation of V_2^M centers into intermediate centers, denoted by V_{2K}^M, becomes observable. Their absorption band lies at 335 nm. With an increase of temperature the V_{2K}^M centers are transformed into V_K^M centers. Based on the works of Hayes and Nichols and that of Crawford and Nelson, the authors consider the V_K^M center to be a Cl_2^- molecular ion situated in a vacancy pair next to a Ca^{2+} ion. Starting from this, and on the basis of experimental results, models are proposed for the structure of V_2^M and V_{2K}^M centers and for the coloration mechanism at higher temperatures. The oscillator strengths of the V_{2K}^M and V_2^M bands are determined with the aid of the models. (auth)

48193 EFFECT OF FAST-NEUTRON IRRADIATION AT AMBIENT TEMPERATURE ON THE LATTICE PARAMETERS OF SILICON AND GERMANIUM CRYSTALS. Baldwin, T. O. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 21: 901-3(Sept. 23, 1968).

The change in the lattice parameter of nearly perfect silicon and germanium crystals irradiated with 4.2×10^{19} fast neutrons/cm² at about 40°C has been measured. The results show an expansion $\Delta a/a$ equal to about 1×10^{-4} in both kinds of crystals. Isochronal annealing experiments on irradiated germanium indicate at least two well-defined annealing regions centered at 150 and 400°C, coinciding with previous anomalous x-ray-transmission experiments. (auth)

48194 EFFECTS OF ^{3}He IRRADIATION ON THE ANISOTROPHY-FIELD INHOMOGENEITY AND COERCIVE FORCE IN THIN PERMALLOY FILMS. Williams, Conrad M. (Naval Research Lab., Washington, D. C.). J. Appl. Phys., 39: 4741-4 (Sept. 1968).

The effects of ^{3}He irradiation on the inhomogeneity in the anisotropy-field magnitude, Δ_{90}, the angular dispersion, α_{90}, and the coercive force, H_c, have been examined for vacuum-deposited thin Permalloy films, with compositions ranging between 43% and 83% nickel. The changes induced in these parameters were developed at 60°C by exposing the films to 2 MeV ^{3}He irradiation, in the presence of a 500 Oe orienting magnetic field applied parallel to the easy-axis directions of the films. The total dosage received by the films was 2×10^{17} particles/cm². As a result of this exposure, the values for both α_{90} and Δ_{90} decreased for all compositions, with the decrease a minimum in the vicinity of 78% nickel. Similarly, the coercive force decreased for most compositions, but was insensitive to irradiation for compositions around 81% nickel. Decreases in α_{90}, Δ_{90}, and H_c were as much as 46% for some compositions; however, much of the decrease in Δ_{90} was primarily the result of an irradiation-induced increase in the average uniaxial anisotropy field, H_k. On the basis of these results it was concluded that the irradiation induces an over-all decrease in the internal strain in the film. (auth)

48195 COULOMB-RECOIL-IMPLANTATION MOESSBAUER EXPERIMENTS WITH ^{73}Ge. Czjzek, Gordon; Ford, J. L. C. Jr.; Love, John C.; Obenshain, Felix E.; Wegener, Horst H. F. (Oak Ridge National Lab., Tenn.). Phys. Rev., 174: 331-45(Oct. 10, 1968).

The 67.03-keV state of ^{73}Ge was populated by Coulomb excitation and the recoiling excited nuclei implanted into Cr, Fe, and Cu backings. Nuclear and solid-state properties of ^{73}Ge were determined by studying the de-excitation γ rays by Mössbauer techniques. The present measurements yield a lifetime of $(2.68 \pm 0.14) \times 10^{-9}$ sec, and favor a spin of $^7/_2$ for the 67.03-keV excited state. The measured isomer shift between pure germanium and GeO_2 is $+1.0 \pm 0.1$ mm/sec, and electron densities calculated for these two cases imply that the radius of the excited state is larger than that of the ground state, and $\Delta R/R = +0.9 \times 10^{-3}$ in reasonable agreement with calculations based on the pairing-plus-quadrupole model. To calculate the recoilless fraction f of an impurity atom, a simple model with spring forces between nearest neighbors is introduced. In each case the effective spring constant for the impurity, as derived from the observed f value, is weaker than that of the host lattice. A remarkable difference was found between f values for tetragonal and hexagonal GeO_2, namely f(tetr) ~ 5f(hex). (auth)

48196 ROLE OF SURFACE DEFECTS IN THE EPITAXIAL GROWTH OF SOME fcc METALS ON POTASSIUM CHLORIDE CLEAVED IN ULTRAHIGH VACUUM. Palmberg, P. W.; Todd, C. J.; Rhodin, T. N. (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys., 39: 4650-62(Sept. 1968).

It has been found that surface defects produced by electron irradiation play a critical role in the formation of single-crystalline films of typical fcc metals such as Au, Ag, and Cu on KCl cleaved in ultrahigh vacuum. Epitaxial films of the $(100)_{Au} \| (100)_{KCl}$, $[100]_{Au} \| [100]_{KCl}$ orientation were produced in a wide range of substrate temperatures on irradiated surfaces at low supersaturation levels. Surface defects produced by irradiation provide nucleation sites which strongly favor the epitaxial orientation for nuclei. The high sensitivity of film orientation to irradiation treatment of the substrate suggests that other known critical factors such as vacuum condition and surface composition may also influence epitaxy through their effect on the nature of the substrate surface upon which nucleation occurs. (auth)

48197 MAGNETIC PROPERTIES OF $PrAl_2$ AND $ErAl_2$. Nereson, N.; Olsen, C.; Arnold, G. (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 39: 4605-9(Sept. 1968). (LA-DC-9291).

The magnetic properties of $PrAl_2$ and $ErAl_2$ have been investigated by neutron-diffraction and susceptibility measurements on powder samples of the above compounds. The susceptibility data show that both compounds obey the Curie–Weiss law; the effective moment per molecule in the paramagnetic region is $3.5 \pm 0.05\ \mu_B$ for $PrAl_2$ and $9.2 \pm 0.1\ \mu_B$ for $ErAl_2$. The neutron-diffraction measurements confirm that these compounds are ferromagnetically ordered below a Curie temperature of 34°K for $PrAl_2$ and 14°K for $ErAl_2$; the respective saturated ordered moments at the rare earth atom sites are $2.94 \pm 0.05\ \mu_B$ and $8.3 \pm 0.3\ \mu_B$. The magnetic form factor data from the $ErAl_2$ coherent magnetic reflections are in good agreement with similar data obtained by other investigators on an Er single crystal. The magnetic scattering intensity of the (111) reflection from $PrAl_2$ was measured just below the Curie temperature T_C in order to determine the long-range magnetic-order temperature dependence. The results show that the spontaneous magnetization M follows a power law in the vicinity of T_C of the form $M \propto (T_C - T)^\beta$, where $\beta = 0.6 \pm 0.1$. (auth)

Theoretical Physics

Refer also to abstracts 48337 and 48338.

48198 (MATT-Trans–65) EXACT SOLUTIONS OF A CLASS OF NONLINEAR WAVE EQUATIONS. Krushkal, E. M. (Akademiya Nauk SSSR, Novosibirsk, Institut Yadernoi Fiziki). Translated by M. Kruskal (Plasma Physics Lab., Princeton Univ., N. J.). from Preprint 197. 5p. Dep. CFSTI.

A simple method of solution of equations of the type $F_1(y_t)y_{tt} = F_2(y_x)y_{xx}$ often occurring in nonlinear mechanics is shown. (auth)

48199 SPECTRAL DENSITY TECHNIQUE IN QUANTUM STATISTICS. Kalashnikov, O. K.; Fradkin, E. S. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 55: 607-24(Aug. 1968). (In Russian).

For solution of quantum-statistic problems, an equation set for the spectral densities is proposed. The effectiveness of the method is illustrated by the solution of the superconductivity model (BCS) and the quantum one-dimensional Ising model with anisotropic interaction. In the latter case, the solution found considerably improves previous results obtained by other methods. (auth)

48200 CLASSICAL CALCULATION OF NONRESONANCE NEGATIVE ABSORPTION IN MAGNETIC FIELD. Gal'tsov, D. V.; Pavlenko, Yu. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 3, 114-16(May–June 1968). (In Russian).

Formulas for electromagnetic wave absorption by electrons moving in a homogeneous magnetic field, in the presence of attenuation characterized by lifetime τ, were derived previously using Einstein's coefficient method. It was also shown that, due to the finite τ with a certain deviation from the resonance ($\omega > \omega_r$), the absorptive power becomes negative and amplification takes place. The amplification effect was calculated within the limits of classical electrodynamics. The problem in this note is reduced to finding the real part of the conductivity tensor σ_{ij}, considering the presence of relaxation. The formula obtained coincides with results derived by quantum mechanics. (R.V.J.)

48201 RADIATION OF CHARGE MOVING IN NONHOMOGENEOUS MAGNETIC FIELD. Bagrov, V. G.; Bordovitsyn, V. A.; Zhuravlev, A. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 3, 107-9(May–June 1968). (In Russian).

Spectral angular distribution and polarization of a charge in motion in an inhomogeneous magnetic field was studied, considering a limited motion (corresponding to the discrete radiation spectra) and only two-dimensional flow. Data obtained showed that the magnetic field inhomogeneity, in general, results in nontrivial changes in radiation, of charge in motion in such a field but certain characteristics of synchrotron radiation are conserved. (R.V.J.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 48387 and 48410.

48202 (BMwF-FBK-68-01) ANNUAL REPORT, 1966. (Physikalisches Staatsinstitut, Hamburg (West Germany). Institut fuer Experimentalphysik (II)). Jan, 1968. 56p. (In German). Dep.

Research includes experimental and theoretical studies in the fields of nuclear and high-energy physics. Concerning nuclear physics investigations, stress is laid mainly on nuclear spectroscopy and the study of the reaction mechanism. These experiments are performed with a 3-MeV Van de Graaff generator and by means of radioactive sources. High-energy physics is investigated especially by analysis of photographs taken in the bubble chambers and by studies of production processes of elementary particles. (auth)

48203 NUCLEAR AND PARTICLE PHYSICS: TWO DIFFERENT SUBJECTS? Chew, Geoffrey F. Comments Nucl. Particle Phys., 11: 107-10(July–Aug. 1968).

Various viewpoints on the division of nuclear and particle physics are discussed, with particular emphasis on the implications of nuclear democracy. (L.B.S.)

48204 SEARCH FOR RELATIVISTIC QUARKS IN THE COSMIC RADIATION. Ashton, F.; Coats, R. B.; Kelly, G. N.; Simpson, D. A.; Smith, N. I.; Takahashi, T. (Univ. of Durham, Eng.). J. Phys., A (London), 1: 569-77(Sept. 1968).

A scintillation counter telescope of aperture 0.47 m^2 sr and incorporating layers of crossed neon flash tubes was used to search for relativistic e/3 and 2e/3 quarks in the near-vertical cosmic radiation at sea level. Events were selected where the scintillator pulse heights were as expected for quarks, and the corresponding flash tube records were studied. No events satisfied all the rigorous acceptance criteria and only upper limits can be given for the quark flux. These are, at the 90% confidence limits: $<1.15 \times 10^{-10}$ cm^{-2} s^{-1} sr^{-1} for relativistic e/3 quarks and $<8.0 \times 10^{-11}$ cm^{-2} s^{-1} sr^{-1} for relativistic 2e/3 quarks. (auth)

Electromagnetic

48205 (ISS-68/20) PROPOSAL FOR AN e^+e^- ELASTIC SCATTERING EXPERIMENT WITH CHARGE RECOGNITION TO BE PERFORMED AT ADONE. Amaldi, U. Jr.; Biancastelli, R.; Matthiae, G.; Tazzari, S.; Ash, W.; Grossman, D.; O'Neill, G. K. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). July 1, 1968. 21p. Dep.

An experiment devoted to the study of elastic electron-positron scattering at Adone is proposed; the apparatus contains a magnetic field by which the charges of the final particles will be recognized and eventually the annihilation amplitude determined. (auth)

48206 (LNF-68/46) WIDE ANGLE ELECTRON PROTON BREMSSTRAHLUNG. Note No. 412. Bernardini, C.; Felicetti, F.; Meneghetti-Vitale, L.; Penso, G.; Querzoli, R.; Silvestrini, V.; Vignola, G.; Vitale, S. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). July 18, 1968. 9p. Dep.

Results are presented of a measurement of wide angle electron proton cross section. The agreement with the quantum electrodynamics prediction is good at the probed masses of 70 and 100 MeV of the virtual electron. (auth)

48207 PHOTOPION REACTIONS IN COMPLEX NUCLEI. Nydahl, G.; Forkman, B. (Univ. of Lund, Sweden. Lund Inst. of Tech., Sweden). Nucl. Phys., B7: 97-110(1968).

The yields of the reactions $^{11}B(\gamma,\pi^-)^{11}C$, $^{27}Al(\gamma,\pi^+)^{27}Mg$, $^{51}V(\gamma,\pi^+)^{51}Ti$ and $^{51}V(\gamma,\pi^-2n)^{49}Cr$ were measured by activation analysis from threshold up to 750 MeV. The true and integrated cross sections have been calculated. The experimental cross sections have been compared with predictions from a Fermi gas model. Fairly good agreement is obtained. (auth)

48208 A DETERMINATION OF THE BRANCHING RATIO $(\eta \to 3\pi^0)/(\eta \to \pi^+\pi^-\pi^0)$. Bullock, F. W.; Esten, M. J.; Fleming-Tompa, E.; Govan, M.; Henderson, C.; Owen, A. A.; Stannard, F. R. (University Coll., London). Phys. Lett., 27B: 402-4(Aug. 19, 1968).

Using a heavy liquid bubble chamber, the branching ratio $(\eta \to 3\pi^0)/(\eta \to \pi^+\pi^-\pi^0)$ is estimated to be $1.47 \pm {}^{0.19}_{0.16}$. This agrees with the theoretical estimate obtained by neglecting $|\Delta I| = 3$ transitions and the effects of final state interactions. (auth)

48209 PHOTOPRODUCTION OF POSITIVE PIONS AT BACKWARD ANGLES IN THE ENERGY RANGE 1 TO 3 GeV. Alvarez, R. A.; Cooperstein, G.; Kalata, K.; Lanza, R. C.; Luckey, D. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 21: 1019-22(Sept. 30, 1968).

A magnetic spectrometer with wide-gap spark chambers was used to measure the single π^+ photoproduction cross sections from hydrogen at lab angles of 110, 127.5 and 152°, between 0.9- and 3.2-GeV photon energy (about 40 photon energies at each angle). The cross section drops fairly rapidly with increasing energy, with superimposed bumps or shoulders at energies corresponding rather closely to the known resonances N(1688), Δ(1920), and Δ(2420). There is a shallow minimum at an energy corresponding to the N(2190) resonance. (auth)

48210 PHOTOPRODUCTION OF π^0 MESONS FROM HYDROGEN AT 180°. Cassiday, G. L.; Fischer, H.; Ito, A.; Loh, E. C.; Rutherfoord, J. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 21: 933-4(Sept. 23, 1968).

The π^0 photoproduction differential cross section was measured at 180° for a range of incident photon energies between 650 and 1750 MeV. The cross sections are dominated by the $D_{13}(1525)$, $D_{15}(1688)$, and $F_{37}(1920)$ resonances. (auth)

48211 IONIZATION ENERGY LOSS OF MUONS IN A PLASTIC SCINTILLATOR. Jones, I. S.; Pathak, K. M.; Thompson, M. G. (Univ. of Durham, Eng.). J. Phys., A (London), 1: 584-7(Sept. 1968).

A study was made of the ionization energy loss of cosmic-ray muons in a plastic scintillator (Ne 102a) over the momentum range 0.3 to 120 GeV/c. The results were combined with those of Crispin and Hayman for a similar material, and together give no support for the decrease expected from the radiative correction theory of Tsytovitch, (1962) the measured change in energy loss above 10 GeV/c being +(1.2 ± 0.7)%, compared with a predicted reduction of 4 to 8%. A least-squares fit to the most probable energy loss values above 2 GeV/c gives a rate of rise of (2.7 ± 3.3)%, a value consistent with that predicted by the theory of Sternheimer (1953). (auth)

48212 ρ PRODUCTION FROM HYDROGEN BY 16-GeV BREMSSTRAHLUNG. Davier, M.; Derado, I.; Drickey, D.; Fries, D.; Mozley, R.; Odian, A.; Villa, F.; Yount, D.; Zdanis, R. (Stanford Univ., Calif.). Phys. Rev. Lett., 21: 841-4(Sept. 16, 1968).

A 2.2-m streamer chamber in a large electromagnet was used with a 16-GeV bremsstrahlung beam to study multibody photoproduction. A report is given on the 851 three-prong, three-constraint kinematic fit events of the type $\gamma p \to \pi^+\pi^-p$; at energies above 6 GeV, these go almost completely to a $p\rho^0$ final state. (auth)

48213 CHERENKOV ENERGY LOSS OF MUONS IN WATER. Alexander, D.; Pathak, K. M.; Thompson, M. G. (Univ. of Durham, Eng.). J. Phys., A (London), 1: 578-83(Sept. 1968).

Using a large directional water Cherenkov counter and a near horizontal magnetic spectrograph, the Cherenkov energy loss of relativistic muons was studied. The experimental results, which cover the range of muon momentum 0.3 to 120 GeV/c, are consistent with the classical theory of Frank and Tamm (1939). They do not indicate a decrease in the Cherenkov loss, as expected according to Tsytovitch (1962), nor do they confirm the large rise reported by Bassi et al. (1952). (auth)

Weak

48214 (COO-1195-128) A MEASUREMENT OF THE RATIO $\gamma(K^- \to \pi^-\pi^0\pi^0)/\gamma(K^+ \to \pi^+\pi^0\pi^0)$ OF THE τ' PARTIAL DECAY RATES. Herzo, D. P.; Banner, D.; Beier, E. W.; (and others) (Illinois Univ., Urbana). [1967]. 13p. (CONF-680809-23). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

An experimental determination of the ratio of the decay rates $\Gamma(\tau'^-)/\Gamma(\tau'^+)$ yielded no evidence for a CP violating $\Delta I = 3/2$ amplitude in the τ decays. (L.B.S.)

48215 MEASUREMENT OF THE RELATIVE PARTIAL DECAY RATES FOR $K^\pm \to \pi^\pm\pi^+\pi^-$. Fletcher, Charles Roberts. Urbana, Ill., Univ. of Illinois, 1967. 111p.

Thesis.

A spark chamber experiment was performed at the Argonne National Laboratory Zero Gradient Synchrotron to measure the relative partial decay rates of positive and negative kaons decaying in the tau mode, $K^\pm \to \pi^\pm\pi^+\pi^-$. The tau decays were ob-

served by photographing the three pions in spark chambers. The kaons in a beam derived from the external proton beam were identified by a threshold and a differential gas Cherenkov counter. The corrected value for the relative tau decay rates was $\Gamma(---+)/\Gamma(++-) = 1.005 \pm 0.009$. The result is consistent with four interpretations. (1) There is no CP violation in $K^+ \to (3\pi)^+$ as seen in the relative tau rates within the experimental error of 0.9%. (2) There are no final state pion interactions. (3) There is a negligible I = 3 contribution to the tau matrix element. (4) There are weak final state pion interactions and a small I = 3 amplitude. (Disser. Abstr.)

48216 MEASUREMENT OF THE TWO-PHONON DECAY OF THE K_L^0 MESON. Todoroff, John Andrew. Urbana, Ill., Univ. of Illinois, 1967. 154p.

Thesis.

The decay $K_L^0 \to 2\gamma$ was observed and the branching ratio was measured in a spark chamber-counter experiment at the Brookhaven AGS. A branching ratio roughly consistent with a model for $K_L^0 \to 2\gamma$ was obtained in which the decay proceeds through virtual π^0 and η^0 states. However, the calculation with this model depends strongly on the unmeasured absolute rate of $\eta^0 \to 2\gamma$ and close comparison with this theory must await a good measurement of the η^0 lifetime. Detection efficiencies for each charged and neutral decay mode were calculated by Monte Carlo techniques. Using these efficiencies, together with the total number of charged coincidences and the 32 events identified as $K_L^0 \to 2\gamma$, we obtain a branching ratio, relative to all modes, of $(6.7 \pm 2.2) \times 10^{-4}$. (TSS) (Disser. Abstr.)

48217 SPARK-CHAMBER STUDY OF ELASTIC NEUTRINO INTERACTIONS. Holder, M. (Technische Hochschule, Aachen); Staude, A.; Boehm, A.; (and others). Nuovo Cim., 57A: 338-54 (Sept. 21, 1968).

Elastic muon production by high-energy neutrinos was studied using the events initiated in the CERN neutrino spark chamber. The contamination with inelastic events was determined assuming the Berman–Veltman cross section for N* production, and taking nuclear interactions of the produced hadrons into account by means of a Monte Carlo method. It is about 45% in the sample selected. The observed distributions of momentum transfers and production angles are best fitted by an axial-vector form factor close to the vector form factors. In the parametrization $F_A = (1 + q^2/M_A^2)^{-2}$ the best estimate of the cutoff momentum M_A is $(0.65^{+0.4}_{-0.2})$ GeV. (auth)

Strong (Baryon-Induced)

Refer also to abstract 47372.

48218 SEARCH FOR A K* BELOW Kπ THRESHOLD IN $\bar{p}p$ ANNIHILATIONS AT REST. Fowler, Earle C. (Duke Univ., Durham, N. C.); Montanet, Lucien; Bizzarri, Romano. Phys. Rev. Lett., 21: 833-5(Sept. 16, 1968).

An upper limit is given for the two-body annihilations $\bar{p} + p \to K + \overline{K}^*$ ($\overline{K} + K^*$), where K* denotes a $J^P = 0^+$, S = +1 resonance with a mass below Kπ threshold. This upper limit is compared with other two-body annihilation processes. (auth)

48219 PARTICLE PRODUCTION AT HIGH TRANSVERSE MOMENTUM. Crabb, D. G. (Univ. of Michigan, Ann Arbor); Day, J. L.; Krisch, A. D.; Lin, M. T.; Marshak, M. L.; Asbury, J. G.; Ratner, L. G.; Read, A. L. Phys. Rev. Lett., 21: 830-2(Sept. 16, 1968).

The differential cross section, $d^2\sigma/d\Omega dp$, for the production of π^+ mesons was measured at high $P_\perp$, in 12.5-GeV/c proton–proton collisions. The range $P_\perp^2 = 1.0-4.0$ $(GeV/c)^2$ was covered and the cross section appeared to break at about 1.5 $(GeV/c)^2$. Thus, $d^2\sigma/d\Omega dp$ appeared to be the sum of two Gaussians in $P_\perp$. (auth)

48220 FORWARD DIFFERENTIAL CROSS SECTIONS FOR THE REACTION $p + p \to d + \pi^+$ IN THE RANGE 3.4 TO 12.3 GeV/c. Anderson, H. L. (Univ. of Chicago, Ill.); Dixit, M.; Evans, H. J.; (and others). Phys. Rev. Lett., 21: 853-7(Sept. 16, 1968).

A spark-chamber missing-mass spectrometer was used to measure the differential cross section for the reaction $p + p \to d + \pi^+$ at closely spaced intervals of incident momentum between 3.4 and 12.3 GeV/c and at small c.m. angle. The data confirm the existence of a prominent peak in the forward cross section at $E_{c.m.} \simeq 2.9$ GeV and show a hitherto unreported shoulder at $E_{c.m.} \simeq 3.6$ GeV. The results make evident the inadequacies of present one-pion-exchange and one-nucleon-exchange models. (auth)

48221 RESULTING DATA ON THE SMALL ANGLE ELASTIC pp AND pd SCATTERING AND THE REAL PART OF THE pn SCATTERING AMPLITUDE IN THE ENERGY REGION 1 TO 10 GeV. Dalkhazhav, N.; Devinski, P. A.; Zayachki, V. I.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 342-7(Aug. 1968). (In Russian).

Tables for differential cross section of the elastic pp and pd scattering in the energy region 1–10 GeV are given as well as the improved data on the value of the real part of the pn-scattering amplitude. Some new data are used. The real part of the pn-scattering amplitude is calculated on the basis of Glauber model for the deuteron interaction. Experimental results are compared with the predictions following from the dispersion relations and with the relations for derivatives of the scattering amplitude at the point t = 0 following from general principles of the quantum field theory. The real part of the pn-scattering amplitude obtained is compared with the data on the no-charge exchange. (auth)

48222 CROSS SECTION OF ELASTIC BACKWARD pd SCATTERING IN THE ENERGY REGION FROM 1 UP TO 3.5 GeV. Bayukov, Yu. D.; Birger, N. G.; Borisov, V. S.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 348-53(Aug. 1968). (In Russian).

The procedure is described and the results are presented of the measurements of the elastic pd-scattering cross section at $T_0 = 3.41$ GeV and $\vartheta_{c.m.} = 145°$. It is found that $(d\sigma/d\Omega)_{c.m.} = (8.1 \pm 1.5) \cdot 10^{-3}$ μbarn/sterad. The available data on the pd scattering at large angles are discussed. (auth)

Strong (Meson-Induced)

48223 (BNL–12769) THE TALE OF TWO "A_2" MESONS. Lai, Kwan Wu (Brookhaven National Lab., Upton, N. Y.). [1968]. 23p. (CONF-680627–1). Dep. CFSTI.

From Conference on Particle Physics, Boulder, Colo.

The properties of the A_2 meson obtained from early bubble chamber experiments are summarized. Results obtained from missing mass experiments at CERN, which yielded evidence of two peaks in the A_2 region are reviewed. Data obtained from recent bubble chamber experiments of the π^-p interaction a 6 GeV/c are reviewed and analyzed. The $\eta(1550)\pi$, $\pi^- +$ neutral, and $K\overline{K}$ decay modes are discussed. It is suggested in conclusion that: (a) A_2^1 and A_2^{II} are distinct and different resonances, and (b) A_2^{II} has the same properties as the "conventional" $I^G\ 1^-$ and $J^P\ 2$ "A_2" meson. (L.B.S.)

48224 (COO–1195–130) A STUDY OF THE K^+-p INTERACTION AT 3.2 AND 2.75 GeV/c. Abrams, G. S.; Eisenstein, L.; O'Halloran, T. A. Jr.; Shufeldt, W.; Whitmore, J. (Illinois Univ., Urbana). [1968]. 15p. (CONF-680809–18). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

Preliminary results are reported on a study of the $K^+p \to K^+\pi^-\pi^+p$ interaction at 3.2 and 2.75 GeV/c in the ANL 30'' hydrogen bubble chamber. At both energies the final state is dominated by the production of K^{*0} (890) and N^{*++} (1236) resonances. A maximum likelihood fit to the data was performed assuming four noninterfering amplitudes (K^*N^*, $K^*p\pi^+$, $K^+\pi^-N^*$, and nonresonant $K^+\pi^-p\pi^+$). (L.B.S.)

48225 (COO-1195-132) 3π MASS SPECTRUM PRODUCED BY π^-p AT 5 AND 7.5 GeV/c. Ascoli, G.; Bridges, C. A.; Crawley, H. B.; Hanft, R. W.; Kruse, U. E.; Mortara, D. W.; Schafer, E. D.; Shapiro, A.; Terreault, B. (Illinois Univ., Urbana). [1968]. 10p. (CONF-680809-19). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

The $\pi^+\pi^-\pi^-$ mass spectrum produced in π^-p interactions was studied for the mass interval 1.0 to 1.4 GeV. The data were taken from 55,000 events obtained at 5 GeV/c in the Berkeley 72'' chamber and 22,000 events at 7.5 GeV/c in the BNL 80'' chamber. Mass distributions are presented for the $\pi^-p \to p(\pi^+\pi^-\pi^-)$, $\pi^-p \to p\pi^0(\pi^+\pi^-\pi^-)$, and $\pi^-p \to n\pi^+(\pi^+\pi^-\pi^-)$ interactions. (L.B.S.)

48226 (COO-1195-134) STUDY OF 4π ENHANCEMENTS IN π^-p AT 5.0 AND 7.5 GeV/c. Ascoli, G.; Bridges, C. A.; Crawley, H. B.; Hanft, R. W.; Kruse, U. E.; Mortara, D. W.; Schafer, E. D.; Shapiro, A.; Terreault, B. (Illinois Univ., Urbana). [1968]. 11p. (CONF-680809-25). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

Results are presented of a study of 4π mass spectra obtained in 5.0- and 7.5-GeV/c π^-p 4-prong interactions. Evidence was found for a fairly strong enhancement in the $(A_2\pi)^0$ spectrum. (L.B.S.)

48227 (ITEF–590) A STUDY OF THE REACTION $\pi^-p \to \Delta^{++}(1236)\pi^-\pi^-$ WITH THE MOMENTUM OF THE π^- MESON AT 3.25 GeV/c. Vetlitskii, I. A.; Guzhavin, V. M.; Kliger, G. K.;

Kolganov, V. Z.; Lebedev, A. V.; Lomkatsi, G. S.; Narodetskii, I. M.; Smolyankin, V. T.; Sokolov, A. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow, Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 19p. (In Russian). Dep.

Eleven hundred and eight events of the reaction $\pi^- p \rightarrow \Delta^{++}(1236)\,\pi^-\pi^-$ were selected and analyzed on 160,000 photographs from the 55 cm hydrogen bubble chamber exposed in the π^- meson beam at 3.25 GeV/c. By means of the modified Chew-Low formula, the values $\sigma_{\pi\pi}(T = 2)$ were obtained for the five regions of the effective masses of two π^- mesons. The scattering length was obtained to be $|\alpha_2| = (1.7 \pm 0.8) \cdot 10^{-14}$ cm. Assuming the purely elastic $\pi^-\pi^-$ interaction, phase analysis was performed aiming to determine the phase shifts δ_{20} and δ_{22}. In the $\pi^-\pi^-$ spectrum there is an enhancement in the region of 800–850 MeV after the events in the ρ^0 band have been excluded. Additional investigations are necessary to confirm this bump. (auth)

48228 (JINR–P1-3947) MESON GENERATION BY MESONS AND DOUBLE-RECHARGE OF π MESONS IN PHOTOEMULSION NUCLEI AT ENERGIES FROM 210 TO 375 MeV. Batusov, Yu. A.; Bunyatov, S. A.; Sidorov, V. M.; Yarba, V. A.; Ionitse, G.; Loznyanu, E.; Mikhul, V.; Tuvdendorzh, D.; Dalkhazhav, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 9p. (In Russian). Dep.

The process of double π^- meson charge exchange at energies above the threshold of meson production was studied. Cross sections for meson production and double charge exchange in $\pi^- + A \rightarrow \pi^+ + A' + \ldots$ and $\pi^- + A \rightarrow \pi^+ + \pi^- + A' + \ldots$ reactions were measured in the energy range from 210 to 375 MeV. (tr-auth)

48229 (UR-875-251) QUASI 2-BODY REACTIONS IN 13-GeV/c K^+p INTERACTIONS. Berlinghieri, J. C.; Farber, M. S.; Ferbel, T.; Forman, B. E.; Melissinos, A. C.; Slattery, P. F.; Yuta, H. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). July 30, 1968. Contract AT(30-1)-875. 17p. (CONF-680809-22). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

The final states pK^{*+} (890), K^0N^{*++} (1236), $K^{*0}N^{*++}$ (1236) and $pK\pi\pi$ (1300) as produced in 12.7 GeV/c K^+p interactions were studied. The density matrix elements and t-distributions were obtained and were compared to theoretical models. A new analysis of the $K\pi\pi$ (1300) confirms the 1^+ spin parity assignment for this mass region and indicates that if the $K\pi\pi$ (1300) is a member of an octet then it belongs to the same octet as the A_1 ($J^{PC} = 1^{++}$). (auth)

48230 CROSS SECTIONS FOR π^+, π^-, K^+, AND K^- MESONS ON COMPLEX NUCLEI. Hassenzahl, William Verne. Urbana, Ill., Univ. of Illinois, 1967. 147p.

Thesis.

A measurement of the absorption and diffraction cross sections of 3.5 GeV/c π and K mesons on beryllium, carbon, aluminum, copper and lead was made at the Zero Gradient Synchrotron at Argonne National Lab. A set of circular scintillation counters measured transmission as a function of angle for each element. Cross sections were then calculated from the observed transmissions. Absorption and diffraction cross sections are given for 3.5 GeV/c π^+, π^-, K^+ and K^- on beryllium, carbon and aluminum, for π^+, π^- and K^+ for copper, and for π^+ and π^- on lead. The diffraction cross sections are found to be larger than the values predicted by optical model calculations. This is discussed in terms of the relative magnitudes of the real and imaginary parts of the nuclear potential. (auth)

48231 THE SEQUENTIAL DECAY $\Sigma(1660) \rightarrow \Sigma(1385)\,\pi \rightarrow \Lambda\pi\pi$ AND A SPIN AND PARITY DETERMINATION OF THE $\Sigma(1660)$. Sims, William Hildreth. Tallahassee, Fla., Florida State Univ., 1967. 159p.

Thesis.

The reactions $K^-N \rightarrow \Lambda\pi^-\pi^0$ and $K^-p \rightarrow \Lambda\pi^+\pi^-$ are examined in the center of mass energy interval 1610–1720 MeV. Both reactions are found to be dominated by the two-body $\Sigma(1385)\pi$ intermediate state, with production from the I = 0 initial state being favored. The results of a partial wave analysis indicate that the $\Sigma(1660)$ is produced in a formation reaction, that it decays via the sequence $\Sigma(1660) \rightarrow \Sigma(1385)\pi \rightarrow \Lambda\pi\pi$, and that it has a spin and parity of $3/2^-$. (Disser. Abstr.)

48232 THE REACTIONS $\pi^-p \rightarrow \rho^0 n$ AND $K^-p \rightarrow K^{*0}(890)n$ AT 11.2 GeV/c. Hyams, B. D. (CERN, Geneva); Koch, W.; Potter, D. C.; Wilson, J. D.; Von Lindern, L.; Lorenz, E.; Luetjens, G.; Stierlin, U.; Weilhammer, P. Nucl. Phys., B7: 1-15(1968).

The results of a spark chamber experiment are reported in which the reactions $\pi^-p \rightarrow \rho^0 n$ and $K^-p \rightarrow K^{*0}(890)n$ were studied at 11.2 GeV/c incident beam momentum. The cross sections are determined to be $\sigma(\rho^0) = 128 \pm 16\ \mu b$ and $\sigma[K^{*0}(890)] = 53 \pm 8\ \mu b$. Differential cross sections and values of the spin density matrix elements are given for both reactions. An enhancement in the $(\pi^-\pi^+)$ invariant mass distribution is observed at a mass of 946 MeV. (auth)

48233 CONTRIBUTION TO THE SEARCH FOR SPINS AND PARITIES OF Y^*'s IN THE 2.0 TO 2.4 GeV MASS REGION. Daum, C.; Erne, F. C.; Lagnaux, J. P.; Sens, J. C.; Steuer, M.; Udo, F. (CERN, Geneva). Nucl. Phys., B7: 19-29(1968).

Data on the elastic scattering of negative kaons on polarized protons in the range of momenta 1.4 to 2.4 GeV/c are analyzed in terms of three diffraction-resonance interference models. The J^P assignments $Y_1^*(2030) = 7/2^+$ and $Y_0^*(2100) = 7/2^-$ are confirmed. For $Y_1^*(2350)$ the data favor the assignments $J^P = 7/2^-$ and $9/2^+$ with slight preference for the latter. The occurrence of dips in the differential cross sections and zero crossings in the polarizations is briefly discussed. (auth)

48234 THE DECAY MODE $\omega \rightarrow e^+e^-$ AND A DIRECT DETERMINATION OF THE ω-ϕ MIXING ANGLE. Bollini, D.; Buhler-Broglin, A.; Dalpiaz, P.; Massam, T.; Navach, F.; Navarria, F. L.; Schneegans, M. A.; Zichichi, A. (CERN, Geneva. Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. Centre de Recherches Nucleaires, Strasbourg). Nuovo Cim., 57A: 404-12(Sept. 21, 1968).

The production reaction $\pi^- + p \rightarrow n + V^0$, $V^0 \rightarrow e^+ + e^-$ at 1.67 GeV/c was studied in the invariant-mass region of the V^0 around the ω mass value, using a system which consisted essentially of two large electron detectors and two large neutron detectors. Eleven events were found, corresponding to a cross section of $(67 \pm 25) \cdot 10^{-33}$ cm^2. The partial width $\Gamma(\omega \rightarrow e^+ + e^-)$ was obtained, and together with the value of $\Gamma(\phi \rightarrow e^+ + e^-)$ was used to obtain a direct determination of the ω-ϕ mixing angle. The following conclusions were derived from the results: (i) the general idea of ω-ϕ mixing is confirmed; (ii) the generalized first Weinberg sum rule works within the 30% experimental uncertainties; (iii) there is no evidence for a coupling of the electromagnetic field to an SU(3) singlet; and (iv) the A-quantum number is not a good quantum number. (L.B.S.)

48235 PRODUCTION AND DECAY OF A_1 AND A_2 RESONANCES IN 16-GeV/c π^-p INTERACTIONS. Ballam, J.; Brody, A. D.; Chadwick, G. B.; (and others) (Stanford Univ., Calif.). Phys. Rev. Lett., 21: 934-8(Sept. 23, 1968).

The total cross sections for production of A_1 and A_2 meson produced in 16-GeV/c π^-p interactions are presented together with angular distributions for their decay. An attempt was made to treat the A_2 as a superposition of two resonant states. (auth)

48236 ANGULAR CORRELATIONS BETWEEN PIONS IN TEN-PRONG π^+-p INTERACTIONS AT 8 GeV/c PRIMARY π^+ MOMENTUM. Eskreys, A.; Wolek, H. (Inst. of Nuclear Research, Krakow). Acta Phys. Pol., 34: 159-63(July 1968).

Strong angular correlations between pions were found in the 10-prong π^+-p interactions at 8 GeV/c. The average opening angle of pion pair of like charges is smaller than that for pairs of unlike pions. This effect appears to be stronger in 10-prong interactions than in 8-prong interactions and much stronger than in 6-prong interactions at the same incoming momentum. (auth)

48237 NEUTRAL NON-STRANGE MESONS NEAR 960 MeV PRODUCED IN 5.5 GeV/c K^-p INTERACTIONS. Davis, R. (Northwestern Univ., Evanston, Ill.); Ammar, R.; Mott, J.; Dagan, S.; Derrick, M.; Fields, T. Phys. Lett., 27B: 532-4(Sept. 16, 1968).

A peak observed near 1 GeV in the $\pi^+\pi^-\pi^0$ mass spectrum in events fitting the reaction $K^-p \rightarrow \Lambda\pi^+\pi^-\pi^0$ is found to arise from the decay of the $X^0(959)$ into $\pi^+\pi^-\gamma$ rather than the H^0. The decay is predominantly via $\rho^0\gamma$ and the decay angular distribution of the ρ^0 agrees well with the $\sin^2\theta$ expectation. A branching ratio $X^0 \rightarrow \rho^0\gamma / X^0 \rightarrow \pi\pi\eta = 0.31 \pm 0.15$ is measured. (auth)

48238 STUDY OF THE TOTAL NEUTRAL CROSS SECTION IN π^-p INTERACTION IN THE MOMENTUM REGION 1.4–4.0 GeV/c. Crouch, H. R. Jr. (Brown Univ., Providence); Hargraves, R.; Lanou, R. E. Jr.; (and others). Phys. Rev. Lett., 21: 845-8(Sept. 16, 1968).

Partial cross sections for π^0 and η^0 production are measured at 12 energies. Pion multiplicities up to five are considered. (auth)

48239 ANGULAR DISTRIBUTIONS OF PION CHARGE-EXCHANGE REACTIONS IN THE MOMENTUM REGION OF 1.4 TO 4.0 GeV/c. Crouch, H. R. Jr. (Brown Univ., Providence); Hargraves, R.; Lanou, R. E. Jr.; (and others). Phys. Rev. Lett., 21: 849-52(Sept. 16, 1968).

Angular distributions are measured at 12 energies. Coefficients of Legendre polynomial expansions of these distributions are given. Also presented are comparisons of the forward and backward cross sections with predictions. (auth)

48240 SEARCH FOR BARYON NKπ RESONANCE WITH THE STRANGENESS S = +1 IN THE REACTION $\pi^- p \rightarrow NK\overline{K}\pi$ AT THE INCIDENT PION MOMENTUM 3.25 GeV/c. Vladimirskii, V. V.; Grigor'ev, V. K.; Grishin, A. P.; Erofeev, I. A.; Il'kov, L. V.; Tikhomirov, G. D.; Trostina, K. A.; Filler, F. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 331-4(Aug. 1968). (In Russian).

The investigation of the final state NK$\overline{K}\pi$ indicates a considerable production of $Y_1^*(1520)$, $Y_0^*(1815)$ and K*(892) resonances at the incident pion momentum 3.25 GeV/c. The evidence is obtained for the possible existence of the NKπ resonances with the positive strangeness with the mass about 1.8 GeV. (auth)

48241 INVESTIGATION OF THE QUASI-TWO-PARTICLE REACTIONS $\pi^- p \rightarrow \rho^0 N^{*0}(1238)$, $\pi^- p \rightarrow \omega^0 N^{*0}(1238)$, $\pi^- p \rightarrow \rho A_2^-$ AT THE MOMENTUM 3.25 GeV/c. Vetlitskii, I. A.; Guzhavin, V. M.; Kaidalov, A. B.; Karnakov, B. M.; Kliger, G. K.; Kolganov, V. Z.; Lebedev, A. V.; Lomkatsi, G. S.; Smolyankin, V. T.; Sokolov, A. P. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 335-41(Aug. 1968). (In Russian).

The quasi-two-particle reactions at the π^--meson momentum 3.25 GeV/c were investigated by means of the hydrogen bubble chamber. The cross sections are found to be 0.310 ± 0.05, 0.210 ± 0.04, and 0.340 ± 0.07 mbarn, respectively. Analyzing the present results in combination with the available data one can conclude that the total cross sections, as well as the differential cross sections, of the processes may be described in framework of the Regge-pole model with exchange by several trajectories. It is found that in the reaction $\pi^- + p \rightarrow \omega^0 + \Delta^0(1236)$ in addition to the ρ-meson pole the B-trajectory exchange contributes essentially (~50–60%). The contribution from the p pole to the reaction $\pi^- + p \rightarrow p + \overline{A}_2$ is estimated to be 60–70%, and the p' and the ρ poles together contribute 40–30%. The behavior of the differential cross section of this reaction at $t \rightarrow 0$ is not in contradiction with the expected behavior on basis of the Regge-pole exchange assuming quantum numbers $J^P = 2^+$ for the A_2 meson. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 48202, 48448, 48612, and 48613.

48242 (AED-C-23-28) HIGH ENERGY PHYSICS INDEX. Volume 6, No. 7 (3601-4134). (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 210p. Dep.

A monthly report of the material received at DESY is presented. (L.B.S.)

48243 (CERN-68-23(Vol.1)) PROCEEDINGS OF THE 1968 CERN SCHOOL OF PHYSICS, EL ESCORIAL, 26 MAY–8 JUNE 1968. (European Organization for Nuclear Research, Geneva (Switzerland)). July 8, 1968. 364p. Dep.

Separate abstracts are prepared for the three lectures included. (L.B.S.)

For abstracts of individual papers see: 48275, 48331, and 48350.

48244 (CERN-68-23(Vol.2)) PROCEEDINGS OF THE 1968 CERN SCHOOL OF PHYSICS, EL ESCORIAL, 26 MAY–8 JUNE 1968. (European Organization for Nuclear Research, Geneva (Switzerland)). July 8, 1968. 157p. Dep.

Separate abstracts are prepared for the three lectures included. (L.B.S.)

For abstracts of individual papers see: 48276, 48413, and 48342.

48245 ON MUTUAL CONNECTIONS BETWEEN PCAC AND CURRENT ALGEBRA. Renner, B. (California Inst. of Tech., Pasadena). Phys. Lett., 27B: 391-3(Aug. 19, 1968).

Arguments are presented which suggest that PCAC is generally applicable only in theories where the once-integrated commutator of axial currents is a conserved vector current. (auth)

48246 CONDITIONS OF ALLOWABLE MASS DISTRIBUTIONS OF UNSTABLE PARTICLES. Khalfin, L. A. (Melekess State Pedagogical Inst., USSR). Dokl. Akad. Nauk SSSR, 181: 584-6 (July 21, 1968). (In Russian).

The following reaction is considered: $m_1 + m_2 \rightarrow m + M \rightarrow m_4 + m_5 + m_6 + m_7$. Here m_i are stable particles, while m and M are unstable particles (resonances). If the laws of conservation of energy and momentum are valid, the masses m and M are related to each other, and the natural question arises on whether arbitrary mass distributions of m and M which are independent of each other are allowable. A momentum analysis shows that if one of the particles, for example m, is stable, an arbitrary mass distribution of the unstable particles becomes possible. The situation is different, however, when both particles m and M are unstable. The problem involves the search for a nonnegative normalized solution of an integral equation with respect to the momenta. It is found that arbitrary mass distributions independent of each other are not allowed in this case. These results are somewhat unexpected, since it has been frequently assumed that the mass distributions of unstable elementary particles do not depend on the mode of preparation (in particular, with what particle they have been associatively generated). This study is being continued. (TTT)

48247 ELEMENTARY PARTICLES. PART II. Kunszt, Zoltan (Lorant Eotvos Univ., Hungary). Fiz. Szemle, 18: 241-8 (Aug. 1968). (In Hungarian).

Experimental data on mesons, based on the quark model are tabulated. They indicate that $^1S_0$, $^1S_1$ and $^3P_1$ nonets have been identified; location of the $^1P_1$, $^3P_0$ and $^3P_1$ nonets is doubtful. It has been generally accepted that there are additional resonances around the 1650 MeV mass but the quantum numbers are not known, although there are some missing-mass spectrometer and bubble chamber data on this subject. SU(3) and SU(6) multiplets have been found in the classification scheme of baryons. The πN phase analysis in the 1200–200 MeV region revealed nine additional nucleon resonances. Major developments may be expected in the field of experimental physics because the 70 GeV Serpukhov accelerator is about to be started, the Weston accelerator is scheduled to be completed by 1972, to operate in the 200–400 GeV range and plans are being prepared at CERN for a 300 GeV accelerator. The expected data are needed to enable the theoreticians to develop a complete theory of strong interactions. (TTT)

48248 SOME REMARKS ON THE PROPERTIES OF FORM FACTORS. Nagel, B. (Royal Inst. of Tech., Stockholm). Nuovo Cim., 57A: 228-44(Sept. 21, 1968).

A study is made of the properties of a class of form factors, vanishing as $t \rightarrow -\infty$, and fulfilling in the cut plane $|F(t)| \leq M_\epsilon \exp[\epsilon |t|^{\frac{1}{2}}] (1 + (\Delta t)^{-m})$ for every $\epsilon > 0$, where Δt is the distance to the cut. A form factor F in this class is uniquely determined by the discontinuity over the cut 2i Im F, which exists as a distribution of finite order. F can be expressed in terms of Im F through a generalized unsubtracted dispersion relation. Sum rules and their implications for the asymptotic behavior of Im F are discussed. (auth)

48249 A LAGRANGIAN FORMULATION OF THE JOOS–WEINBERG WAVE EQUATIONS FOR SPIN-s PARTICLES. Shay, D. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 57A: 210-18(Sept. 21, 1968).

The Lorentz covariant, spin-s, Joos–Weinberg equations are derived from a Lagrangian. This Lagrangian is written entirely in terms of an auxiliary field $\varphi(x)$ and the Joos–Weinberg wave function $\psi(x)$ is defined in terms of $\varphi(x)$. The function $\psi(x)$ describes a free, massive, spin-s particle, while $\varphi(x)$ describes a free, massive, spin-s particle "decorated" with massless, spin-s neutrinos. The question of whether $\psi(x)$ or $\varphi(x)$ is the wave function corresponding to reality is discussed. The interpretation of $\psi(x)$ as the actual wave function is favored. (auth)

48250 NUCLEAR AND PARTICLE PHYSICS. Proceedings of 1967 Summer Institute in Nuclear and Particle Physics held at McGill University, Montreal, August 7–18, 1967. Margolis, B.; Lam, C. S. (eds). New York, W. A. Benjamin, Inc., 1968. 553p.

There were nine lectures. Separate abstracts were prepared for each lecture. (J.F.P.)

For abstracts of individual lectures see: 48251, 48252, 48264, and 48623–48628.

48251 THEORY OF SOURCES. Schwinger, J. (Harvard Univ., Cambridge, Mass.). pp 509-547 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

A particle theory intermediate between field theory and S-matrix theory is discussed. It treats both aspects of a particle, its localizability and energy-momentum properties, in an entirely symmetrical way. This theory shares with conventional relativistic quantum field theory the feature that it can describe the space-time properties of a particle, although not necessarily at arbitrarily small distances. It describes the particle within a space-time region defined by the experiment in which the particle enters. The feature that it can describe the energy–momentum characteristics of a particle is shared with S-matrix theory. The theory differs from field theory in that it involves no operators. The basic notion is that of a source for a particle, and that is described by a

numerical function. The particle theory differs from S-matrix theory in that it takes into account the fact that a particle has another complementary aspect to its energy–momentum characteristics, a degree of localizability. Also in contrast to S-matrix theory it assumes no analyticity properties. (J.F.P.)

48252 CHIRAL ALGEBRA AND DYNAMICS. Bardeen, W. A.; Lee, B. W. (State Univ. of New York, Stony Brook). pp 273-309 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

The achievements of current algebra in its application to various phenomena are examined. After defining the chiral current algebra a typical method of extracting physical predictions is illustrated by a few examples. It is found that in most of the applications there exist considerable ambiguities in extracting observable consequences from current algebra. It is made clear that current algebra can only make definite predictions for off-shell amplitudes. To obtain on-shell amplitudes, an additional assumption must be made about the smoothness of extrapolation from off- to on-shell amplitudes. This assumption (PCAC) is at best vague. The method of chiral dynamics for easily obtaining results of current algebra is then discussed. (J.F.P.)

48253 SATURATION OF THE ISOSPIN-FACTORED CURRENT ALGEBRA AT INFINITE MOMENTUM. Chang, Shau-jin; Dashen, R. F.; O'Raifeartaigh, L. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Lett., 21: 1026-9(Sept. 30, 1968).

The angular conditions for the isospin-factored current algebra at infinite momentum are decomposed into a set of momentum-transfer-independent conditions. The solutions to the angular conditions are constructed and related to wave equations. The existence of spacelike solutions is established for any nontrivial solution, and the decoupling problem is discussed. (auth)

48254 ELEMENTARY PARTICLES. Geheniau, J. Bull. Cl. Sci., Acad. Roy. Belg., 53: 1406-16(1967). (In French).

The expansion of the concept of elementary particles since 1931 when the entire field was comprised by the electron, photon, and proton is briefly outlined. The characteristics used to distinguish the more than 200 presently known elementary particles are summarized. These include mass, baryon number, lepton number, spin, and parity. Strong, weak, and electromagnetic interactions are elementary particles considered. The storage rings available or under development to study at greater depth the characteristics of elementary particles are briefly indicated. (J.S.R.)

Electromagnetic

Refer also to abstract 48360.

48255 (IC-68/75) ON THE DIVERGENT PART OF THE SECOND-ORDER ELECTROMAGNETIC CORRECTIONS TO THE RATIO G_A/G_V. Sirlin, A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug. 1968. 34p. Dep.

The divergent part of the second-order electromagnetic corrections to the axial vector matrix elements is studied, using a simple extension of the Bjorken limit to the case involving the time-ordered product of three currents (or local operators). Under certain conditions it is shown that the second-order corrections to G_A/G_V (in neutron β decay) are finite in the simple intermediate boson model. Uncompensated logarithmic divergences in the overall corrections to G_A/G_V are found with coefficients which appear to be highly model dependent. The effect of operator gradient terms and the possible connection with the well-known divergences in the electromagnetic mass shifts is discussed. The case of the $SU_3 \otimes SU_3$ algebra of fields is studied separately. Thus, by applying this method, the case of the algebra of fields Schwinger's interpretation of the Bjorken correction factor is recovered as well as his expressions for the divergent parts of the mass shifts of the charged vector and axial vector mesons. It is pointed out that, in the broader context of current algebra, such identifications are model dependent. This is illustrated by examining, on the basis of the approach of this work, the familiar example of muon decay. (L.B.S.)

48256 (LNF-68/38) VIRTUAL PROTON COMPTON EFFECT AND THE ELECTRON (MUON)–PROTON BREMSSTRAHLUNG AS A TEST OF QUANTUM ELECTRODYNAMICS. Note No. 405. Greco, M.; Tenore, A.; Verganelakis, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). June 27, 1968. 32p. Dep.

The virtual proton Compton effect is studied in the approximation of a single virtual proton and a 3-3 resonance. The computation of the latter intermediate state is carried out in the framework of isobaric formalism. The contribution to the measurements of the wide angle bremsstrahlung, arising from the virtual proton Compton terms, is given explicitly. It is shown that these contributions depend strongly on the kinematical configuration of the experiments and may change appreciably the results of pure QED in the critical region where the intermediate electron or muon is far off its mass shell. The numerical results suggest that the exponential from factor is a more reasonable one, to describe the behavior of the γNN^+ vertex form factor. In addition it is pointed out that proton polarization measurements in the wide-angle bremsstrahlung and large angle pair production experiments, provide a new important source of information about the contribution of the virtual proton Compton effect to these processes. Polarized cross sections are explicitly calculated. (auth)

48257 (LNF-68/40) p-p AND e-p ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFERS. Note No. 407. Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). July 2, 1968. 5p. Dep.

A new approach to the problem of relating the p-p and e-p scattering at high energy is proposed, which consists of identifying asymptotically the square of the electromagnetic form factor $G_{Mp}(t)$ with the factor $P_{NS}(t)$, where $P_{Np}(t)$ is defined as the probability that a proton does not break up when the momentum transfer takes the value t. The plots of $(G_{Mp}(t)/\mu)^2$ and the p-p differential cross section as functions of rt are formed to be in good agreement with experimental data. (L.B.S.)

48258 ELECTROMAGNETIC EFFECTS OF THE NUCLEON–NUCLEON INTERACTION. Wilson, Richard. Comments Nucl. Particle Phys., 11: 103-6(July-Aug. 1968).

A survey is given of the recent advances in the study of electromagnetic effects of the nucleon–nucleon interaction. Experiments and calculations on bremsstrahlung in nucleon–nucleon collisions are discussed. (L.B.S.)

48259 ELECTROMAGNETIC CORRECTIONS TO $K \rightarrow 3\pi$ RATES. Neveu, A.; Scherk, J. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett., 27B: 384-6(Aug. 19, 1968).

Part of the electromagnetic corrections to $K \rightarrow 3\pi$ rates, and their consequences on the predictions of various selection rules in nonleptonic decays of kaons are calculated in a simple model; comparison is made with experimental data. (auth)

48260 CURRENTS AS COORDINATES AND FINITE ELECTROMAGNETIC CORRECTIONS. Jackiw, R. (CERN, Geneva. Harvard Univ., Cambridge, Mass.). Phys. Lett., 27B: 394-7 (Aug. 19, 1968).

It is shown that a rapid decrease of the forward Compton amplitude signals the fact that the electromagnetic current components can be chosen to be canonical coordinates, and that they satisfy a wave equation appropriate to spin-1 fields. (auth)

48261 SOME REMARKS ON THE ELECTROMAGNETIC FORM FACTORS OF THE PROTON. Morpurgo, G. (Univ., Genoa. INFN, Genoa). Phys. Lett., 27B: 378-80(Aug. 19, 1968).

It is suggested that the trend of the present deviations from the dipole fit of the electromagnetic form factor of the proton might be interpreted as indicating a depression or a hole in the charge density of the proton near the center. (auth)

48262 NONFORWARD PHOTOPRODUCTION OF ρ^0 MESONS FROM COMPLEX NUCLEI. Fleischer, J. (Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Phys., B7: 47-52(1968).

The nonforward coherent photoproduction of ρ^0 mesons was calculated following closely the model of Drell and Trefil, and Ross and Stodolsky. Inside the nucleus the ρ^0 wave function shall satisfy the Klein–Gordon equation with a purely imaginary potential. From the wave function at the nuclear surface the production amplitude is constructed by the Kirchhoff method known from classical optics. In a recent experiment indications of diffraction minima and maxima have been observed, the general features of which seem to be well reproduced by this calculation. (auth)

48263 IS THE ADLER–FUBINI SUM RULE SACRED? Barry, George W.; Gounaris, G. J.; Sakurai, J. J. (Enrico Fermi Inst., Chicago. Univ. of Chicago). Phys. Rev. Lett., 21: 941-3(Sept. 23, 1968).

It is conjectured that the Adler–Fubini sum rule does not necessarily hold in a world where the Schwinger term is finite and the propagator of the isospin current has a convergent spectral representation. A modified sum rule is proposed. (auth)

48264 RADIATIVE CORRECTIONS TO WEAK INTERACTIONS. Kaellen, G. (Univ. of Lund, Sweden). pp 123-97 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

Muon decay is discussed in some detail in order to explain the technique used for beta decay. This is then discussed with special consideration of the problems which occur due to strong interac-

tions. Among the topics treated are nuclear beta decay, mesonic beta decay, and current algebra for radiative corrections. (J.F.P.)

48265 THE THEOREM OF CARRUTHERS AND THE DECAY OF POSITRONIUM. Speiser, D. (Univ. of Louvain, Belgium); Picasso, L. E. Nuovo Cim., 57A: 446-9(Sept. 21, 1968).

The decay of positronium in the singlet S-state into two and not three photons has been attributed to invariance under charge conjugation alone. It is shown that due to the theorem of Carruthers the decay $^1S_0 \to 3\gamma$ would be in contradiction with the requirements of local field theory. It is also shown that although the problem of the group extension by charge conjugation leads in general to several solutions, some of them are ruled out by the requirements of local field theory. (L.B.S.)

48266 TWO-PHOTON DECAYS OF 2^+ MESONS. Radutskii, G. M. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz., 8: 115-18(July 1968). (In Russian).

A nontrivial set of equations for the amplitudes of two-photon decays of tensor mesons is obtained using the dispersion sum rules for the process $\gamma + \gamma \to P_1 + P_2$, where P_1 and P_2 are neutral pseudoscalar mesons. It is shown that the ratio $W(f^0 \to \gamma\gamma)/W(A_2^0 \to \gamma\gamma)$ does not agree with the SU_3-symmetry predictions. (auth)

48267 DISPERSION SUM RULES AND ELECTROMAGNETIC PROPERTIES OF HIGHER RESONANCES. Aznauryan, I. G.; Solov'ev, L. D. Yadern. Fiz., 8: 129-37(July 1968). (In Russian).

Contributions from higher resonances to the dispersion sum rules for Compton scattering on particles with arbitrary spin, in particular for the scattering on baryons, are discussed. Estimates of the widths of the radiational decays $\Lambda(1405) \to Y + \gamma$ and $\Lambda(1520) \to Y + \gamma$ are given. The sum rules for the magnetic moments of the baryon $^3/_2^+$ decuplet are also considered. (auth)

48268 HIGH-ENERGY APPROXIMATION IN PARTICLE SCATTERING ON NUCLEI. Pol, Yu. S.; Luk'yanov, V. K.; Petkov, I. Zh. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., 34: 49-61(July 1968). (In Russian).

The Dirac equation with an optical potential $\overline{V} = V + iW$ was resolved using high-energy approximation $|\overline{V}|/E \ll 1$. The functions obtained were used for constructing scattering amplitudes and calculating differential cross sections for small $\vartheta < (kR)^{-1}$ and large $\vartheta > (kR)^{-1}$ scattering angles. The universal results for electron scattering on nuclei are obtained in the cases in which absorption is absent (W = 0) and the particle mass is not taken into account. Formulas were also obtained for a nonrelativistic case in which $|\overline{V}| \ll E_{kinet} \ll M$. (tr-auth)

48269 PROTON–PROTON BREMSSTRAHLUNG AT 3.2 MeV. Silverstein, E. A.; Kibler, K. G. (Case Western Reserve Univ., Cleveland). Phys. Rev. Lett., 21: 922-5(Sept. 23, 1968).

The proton-proton bremsstrahlung cross section was measured with an incident energy of 3.2 MeV at an angle of 30° in the coplanar symmetric geometry. The result for the cross section, $d^2\sigma/d\Omega_1 d\Omega_2$, is $0.15^{+}_{-}{}^{0.3}_{0.3}$ $\mu b/sr^2$, and is compared with theory. (auth)

48270 BOSON RESONANCES OF ANY SPIN IN $\gamma\pi - \pi\pi$ AND $\gamma\pi - \gamma\pi$. Schiller, D. H.; Avram, N. (Univ. of Timisoara, Rumania). Acta Phys. Pol., 34: 177-9(July 1968).

The exchange of boson resonances M^j of any (integer) spin $j \geq 1$ in photoproduction of pions on pions and Compton scattering on pions is considered. (auth)

48271 $e^+ - e^-$ ANNIHILATION AND THE RARER DECAY MODES OF ω AND ρ. Donnachie, A. (CERN, Geneva). Phys. Lett., 27B: 525-6(Sept. 16, 1968).

Coherent $\omega - \rho$ interference in the reactions $e^+ + e^- \to \pi^+ + \pi^-$ and $e^+ + e^- \to \pi^0 + \gamma$ is studied as a source of information on the decays $\omega \to \pi^+ + \pi^-$ and $\rho^0 \to \pi^0 + \gamma$. (auth)

48272 LOW ENERGY THEOREMS TO FOURTH ORDER IN e FOR COMPTON SCATTERING. Roy, S. M.; Singh, Virendra (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Lett., 21: 861-4(Sept. 16, 1968).

Low-energy theorems for Compton scattering are proved, which are exact when the electromagnetic interaction is included up to fourth order and the strong interactions to all orders. These theorems give the terms of order $\omega^2 \ln\omega$, where ω is the photon c.m. momentum, besides establishing the classical low-energy theorem to the order e^4. (auth)

48273 VECTOR DOMINANCE, REGGE POLES, AND π^0 PHOTOPRODUCTION. Harari, Haim (Weizmann Inst. of Science, Rehovoth, Israel. Stanford Univ., Calif.). Phys. Rev. Lett., 21: 835-8(Sept. 16, 1968).

The presently accepted Regge parametrization of π^0 photoproduction claims that the $t \sim -0.5$ BeV^2 cross section is completely provided by B exchange. It is shown that this statement disagrees with vector dominance by a factor of at least 4 and probably 10 or more. Additional I = 0 poles or cuts are needed both in this process and in the I = 0 t-channel combination of $\pi + N \to \rho + N$ cross sections. (auth)

48274 ARE TWO-GAMMA DECAYS UNIVERSAL? Krolikowski, W. (Univ. of Warsaw. Inst. for Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 16: 523-5(1968).

It is noted that the decays $\pi^0 \to 2\gamma$ and $\eta \to 2\gamma$ are approximately of equal strength. It is suggested that this feature may be a manifestation of a new Fermi-like universal interaction which possibly couples two photons with the neutral SU(3) currents of hadrons. (L.B.S.)

Weak

Refer also to abstracts 48264 and 48314.

48275 (CERN–68-23(Vol.1), pp 129-234) WEAK INTERACTIONS. Pascual, Pedro (Univ., Valencia).

The throry of weak interactions is reviewed. The topics discussed include: beta decay; muon decay; universal weak interactions; conserved vector current; Cabibbo's theory; calculations of θ_V and θ_A; semileptonic decays of hyperons; K_{l3}; nonleptonic decays of kaons; and problems of nonleptonic decays. (L.B.S.)

48276 (CERN–68-23(Vol.2), pp 365-430) HIGH-ENERGY NEUTRINO INTERACTIONS. Perkins, D. H. (Nuclear Physics Lab., Oxford).

A review is given of the theoretic and experimental results of high-energy neutrino interactions. A preliminary discussion is given of the V-A theory of the current-current interaction, CVC and the universal Fermi interaction, PCAC, and the Cabibbo theory. The properties of the weak hadronic currents, their selection and conservation rules and the associated form factors are dealt with. The properties of the lepton current are then considered in more detail. (L.B.S.)

48277 (IFVE-SEF/STF–68-6-K) CONCERNING SEARCHES FOR HEAVY LEPTONS BY THE OBSERVATION OF THEIR FREE PATHS. Makeev, V. V.; Folomeshkin, V. N. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). 1968. 14p. (In Russian). Dep.

The spectra dN/dE of the heavy leptons being produced in the reactions $\nu n \to lp$, the path length distribution dN/dx of the heavy leptons, the number of heavy leptons N(x) having the path more than x have been computed. The computations were made for the CERN neutrino spectrum, for the spectra of neutrinos expected at the IHEP accelerator and for the various masses of the heavy leptons. The results are represented as plots. (auth)

48278 FIELD-CURRENT IDENTITY, UNIVERSALITY, AND K_{l3} DECAY. Lo, S. Y. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys., B7: 68-78(1968).

The dependence of the form factor on the momentum transfer squared is studied in three cases. (i) The universality relation $F^0_{\pi\pi}(0) = F^0_{KN}(0)$ is generalized to small q^2 by means of field-current identity and a "universality" model. (ii) The q^2-dependence of the weak form factor of the pion (kaon) $f_\pi(q^2)$ ($f_K(q^2)$) is found to be related to that of the pion (kaon) charge form factor. (iii) The K_{l3} decay parameters λ_+, λ_-, $\xi(0)$ are calculated in two models. They are compatible with present experimental data. Special attention is paid to the hard-pion (-kaon) and soft-pion (-kaon). (auth)

48279 STRUCTURE OF THE WEAK INTERACTION $\Lambda + N \to N + N$ AND THE SU(6) SYMMETRY. Filimonov, V. A.; Nikiforov, B. P. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz., 8: 71-3 (July 1968). (In Russian).

Assuming that the weak interaction $\Lambda N \to NN$ transforms like a component of the 35 representation of the group SU(6), it is concluded that the $^3S_1 \to {}^3S_1$ and $^1S_0 \to {}^1S_0$ amplitudes of $\Lambda p \to pn$ are equal up to a sign. With the further assumption about the Blok–Dalitz structure for the $\Lambda N \to NN$ interaction the result is obtained that in nonmesonic decays of light hypernuclei only those transitions with the change of the parity are allowed and there is no asymmetry. (auth)

48280 ON THE RENORMALIZATION THEORY OF WEAK INTERACTION. Shabalin, E. P. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 74-80(July 1968). (In Russian).

The Tanikawa–Watanabe model for the renormalizable theory of weak interaction is investigated from the standpoint of the existing experimental data. The variant of the theory, as presented by Tanikawa and Watanabe, is shown to be in contradiction with the data

available. A new variant that is in agreement with modern data is established. In this variant, the corrections and correlations in $e^{\pm}p$, $\mu^{\pm}p$ scatterings due to weak interactions prove to be considerable, so the validity of the theory may be tested if the experimental precision be increased. (auth)

48281 SPIN EFFECTS IN REGENERATION OF K^0 MESONS. Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 81-90(July 1968). (In Russian).

Spin dependence of the K^0-nucleus interaction amplitudes (for the spin ≥ 1) results in the dependence of the regeneration amplitude on the nucleus spin. The relation between the coherent and the diffractional regenerations differs from that in case of spinless and spin-½ nuclei. The variations in the general formulas, interference phenomena after the regeneration on the aligned nuclei, and the Kobzarev–Okun experiment with an aligned target, are considered. (auth)

48282 WHAT EXPERIMENTAL DATA CAN BE USED TO DETERMINE THE $\Delta T = ½$ RULE VIOLATION EXTENT IN THE $K \to 3\pi$. Anisovich, V. V.; Dakhno, L. G.; Likhoded, A. K. (Inst. of High-Energy Physics, Serpukhov, USSR). Yadern. Fiz., 8: 91-8(July 1968). (In Russian).

A problem of the effect of the mass difference of π and K mesons on the determination of the $\Delta T = ½$ rule violation extent is studied. It is shown that in the total decay probabilities the mass difference effect cannot be totally excluded dividing the total probabilities by the phase-space volume as it it usually done. Due to the mass difference, the position of the physical region (as well as the position of the central point of the Dalitz plot) is changed. Since the matrix elements of the $K \to 3\pi$ decays strongly depend on the π-meson energy, this results in considerable corrections to the total decay probabilities (of the order of 10%). As a result it appears, that if one claims the accuracy of the order of 10%, then assuming the $\Delta T = ½$, one has only one relation between the total decay probabilities. Only transitions with $\Delta T = ⅝$ and $\Delta T = 7/2$ violate these relations. In conclusion, other possibilities to determine corrections to the $\Delta T = ½$ in the $K \to 3\pi$ decays are discussed. (auth)

48283 POSSIBLE EXPERIMENTS ON SEARCH FOR THE MIRROR K^0 MESONS. Nikolaev, N. N.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 99-105(July 1968). (In Russian).

A possibility of searching experimentally for the mirror K mesons is discussed. It is shown that analyzing the photographs obtained during the neutrino experiment at CERN, one may put an upper bound for the amplitudes of interactions between the mirror particles and the ordinary particles. Detection of the K-meson decays that are not related to stars on photographs may be an indication to the existence of the mirror K mesons. (auth)

48284 ON $\Xi \to \Lambda\pi\gamma$ DECAYS. Zakharov, V. I.; Kondratyuk, L. A.; Ponomarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 106-14(July 1968). (In Russian).

It is shown that the amplitudes of the transitions $\Xi^- \to \Sigma^0\pi^-$ and $\Xi^0 \to \Sigma^0\pi^0$ can be found by measuring the probability of the hard photon emission and the correlation between hyperon spins and the direction of the γ quanta emission in the decays $\Xi^- \to \Lambda\pi^-\gamma$, $\Xi^0 \to \Lambda\pi^0\gamma$. Determination of these amplitudes are of interest, particularly from the standpoint of checking the unitary symmetry that makes it possible to express matrix elements of the transitions $\Xi \to \Sigma^0\pi$ in terms of amplitudes of observable nonleptonic transitions of the hyperons. Partial widths that are to be measured are about 10^{-5} to 10^{-6} of the total width. (auth)

48285 RADIATIVE CORRECTIONS TO NEUTRON β-DECAY. de Alwis, S. P. (Cambridge Univ., Eng.). Nuovo Cim., 57A: 395-403(Sept. 21, 1968).

It is shown that the divergent parts of the second-order radiative corrections to the axial vector coupling constant (in neutron β-decay) do not satisfy universality. (auth)

48286 QUASI-ELASTIC SCATTERING OF LEPTONS FROM NUCLEI AND THE DETERMINATION OF THE AXIAL-VECTOR FORM FACTOR. Loevseth, J. (CERN, Geneva. Inst. of Physics, Oslo). Nuovo Cim., 57A: 382-94(Sept. 21, 1968).

Quasi-elastic scattering of electrons is discussed in terms of simple independent-particle models and compared to experimental data for carbon. The same models are applied to elastic neutrino reactions and a method based on the maximum-likelihood principle is proposed to determine the axial form factor. The method depends only on the observed angle and momentum of the muon and on the shape of the neutrino spectrum. An application is made to the CERN 63-64 HLBC data. (auth)

48287 A POLE MODEL FOR $K_2^0 \to 2\gamma$ DECAY. Savoy, C. A.; Zimerman, A. H. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Nuovo Cim., 57A: 201-9(Sept. 21, 1968).

The decay $K_2^0 \to 2\gamma$ is studied in the framework of a pole model. In addition to the usual treatment which considers only intermediate pseudoscalar particles, models are discussed with vectors and axial particles as poles. (auth)

48288 ASYMPTOTIC SU_3 AND K_{l3} DECAY FORM FACTORS. Srivastava, P. P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo Cim., 57A: 454-6(Sept. 21, 1968).

It was previously suggested by Gell–Mann that the SU(3) symmetry, even though badly violated due to observed large mass differences within a multiplet, may still be a good symmetry when high energies and momentum transfers are involved. This idea is applied to the K_{l3} and π_{l3} decay form factors when some of the form factors satisfy subtracted dispersion relations. The results are found to be in good agreement with experiment. (L.B.S.)

48289 CONTINUUM CONTRIBUTIONS TO VECTOR-MESON DECAYS. Vaughn, Michael T. (Northeastern Univ., Boston); Wali, Kameshwar C. Phys. Rev. Lett., 21: 938-40(Sept. 23, (1968).

A model for estimating continuum contributions to vector-meson propagators is constructed and used to predict the rate of vector-meson decay into lepton pairs, and a modification of the SU(3) prediction for the rate of φ decay into $K + \bar{K}$. The pion electromagnetic form factor obtained in our model is also compared with that determined by the Novosibirsk group using the reaction $e^+ + e^- \to \pi^+ + \pi^-$. (auth)

48290 ALGEBRA OF CURRENTS, DIVERGENCE OF STRANGENESS-CHANGING VECTOR CURRENTS, UNSUBTRACTED DISPERSION RELATIONS, AND THE K_{l3} FORM FACTORS. Kang, Kyungsik (Brown Univ., Providence). Phys. Rev. Lett., 21: 857-60(Sept. 16, 1968).

On the basis of current algebra, the Nambu–Sakurai hypothesis of partial conservation of strangeness-changing vector currents, and unsubtracted dispersion relations for $f_+(q^2)$ and $q^2f_-(q^2)$, the K_{l3} parameters ξ, λ_+, and λ_- are found to be consistent with the present experimental indications. The only input in the theory is $F_K/F_\pi f_+(0) = 1.28$ from the Cabibbo theory. The mass of the conjectured κ is in agreement with the recently reported result of broken chiral symmetry. (auth)

48291 ENERGY AND ANGULAR DISTRIBUTIONS FOR MESONIC DECAYS OF HYPERNUCLEI. Lyul'ka, V. A. Yadern. Fiz., 8: 360-70(Aug. 1968). (In Russian).

Energy spectra and angular correlations of particles from the decays of the hypernuclei $He^5_\Lambda \to He^4 + p + \pi^-$, $He^4_\Lambda \to He^3 + p + \pi^-$, and $H^4_\Lambda \to H^3 + p + \pi^-$ are calculated. The Pauli principle and the final-state interaction are taken into account. The results are compared with the available experimental data. (auth)

48292 ELECTROMAGNETIC T-ODD CORRELATIONS IN THE DECAYS $\Lambda \to pe\bar{\nu}$ AND $\Sigma^- \to ne\bar{\nu}$. Kopeliovich, V. B.; Tverdokhlebov, A. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 371-8(Aug. 1968). (In Russian).

The T-odd correlations in the decays $\Lambda \to pe\bar{\nu}$ and $\Sigma^- \to ne\bar{\nu}$ due to the electromagnetic final-state interactions are calculated. The calculations are fulfilled assuming zero electron mass and up to $\sim(p/M)^2$ terms, where p is the momentum of one of the emitted particles and M is the nucleon mass. For the correlation between the Λ polarization and the normal to the decay plane, that is anomalously small in the first nonvanishing approximation as compared with other correlations, the contribution from the second-order terms is found to exceed by the factor of two or three the contribution from the first-order terms and has the opposite sign. For other three possible correlations the contribution from the second-order terms is as large as 40 to 50% of the contribution from the first-order terms. For the decay $\Sigma^- \to ne\bar{\nu}$ the contribution from the second-order terms is about 30%. (auth)

Strong (General)

48293 (INP–599) THREE LECTURES ON PHENOMENOLOGY OF MULTIPARTICLE PROCESSES AT HIGH ENERGY. Bialas, A. (Institute of Nuclear Physics, Krakow (Poland)). Apr. 1968. 22p. Dep.

The fundamental ideas of the recent theoretical work on multiparticle production processes are reviewed. The first lecture deals with the kinematics, the uncorrelated jet model, the simple peripheral model, and the multiperipheral model. A particular example of the application of the multiperipheral model to the study of three-body final states produced in high-energy collisions of hadrons is considered in the second lecture. Some work on multi-particle processes done recently by experimental groups in Cracow and Warsaw is reviewed in the third lecture. (L.B.S.)

48294 GENERAL PROPERTIES OF REGGE FAMILIES IN THE WICK-CUTKOSKY MODEL. Gatto, R. (CERN, Geneva); Menotti, P. Phys. Lett., 27B: 381-3(Aug. 19, 1968).

General properties of Regge families as the coupling goes to zero or as the square of the energy goes to minus infinity are studied in the Bethe-Salpeter equation with zero mass exchange. Cutkosky-Deo mixings are shown to occur. (auth)

48295 CLASS OF GROUP-THEORETICAL SOLUTIONS OF THE GENERAL CONSPIRACY PROBLEM. Cosenza, G.; Sciarrino, A.; Toller, M. (International Atomic Energy Agency, Trieste, Italy). Phys. Lett., 27B: 398-401(Aug. 19, 1968).

The behavior at t = 0 of the factorized residues of a family of parallel Regge trajectories is calculated by a generalization of the Lorentz group formalism. Both equal and unequal mass reactions are considered. The symmetry with respect to the exchange of identical particles is taken into account. The generalized Lorentz pole contributions to the high-energy forward scattering are given. (auth)

48296 D/F RATIO, N*(1400) PRODUCTION AND REPRESENTATION MIXING IN THE ALGEBRA OF VERTEX STRENGTHS. Horwitz, L. P.; Kantorovich, A. (Tel-Aviv Univ., Israel). Nuovo Cim., 57A: 450-3(Sept. 21, 1968).

A classification scheme based on the 364-dimensional representation of U_{12} is considered for calculation of coupling vertex strengths for baryon–baryon and baryon–meson scattering. This scheme allows a combination of states for the proton to be obtained which gives the required amount of D admixture. In order to keep the ratio $\sigma(\pi p)/\sigma(pp) = 2/3$ prediction for high-energy diffraction scattering unchanged, the mesons are assigned to the 143-dimensional representation of U_{12} and the induced mixture of states is determined. The ratio of N*(1400) resonance production to the p-p elastic scattering is also treated in the framework without introducing new parameters. (L.B.S.)

48297 SUPERCONVERGENT SUM RULE FOR A COMBINATION OF FOUR ELASTIC CHANNELS. Seth, V. P.; Agarwal, B. K. (Allahabad Univ., India). Nuovo Cim., 57A: 433-5(Sept. 21, 1968).

Several elastic channel πN, $KN + \bar{K}N$, $\pi\pi$, and πK interactions that involve the same Regge pole ρ are considered, and a superconvergent sum rule is constructed for a combination of their amplitudes. The corresponding sum rule is then tested. (L.B.S.)

48298 STABLE AND UNSTABLE STATES IN THE Vθ SECTOR OF THE LEE MODEL. Mineev, V. S. (Moscow State Univ.). Zh. Eksp. Teor. Fiz., 55: 506-11(Aug. 1968). (In Russian).

The behavior of the propagator of the Vθ coupled state in the Lee model is studied by employing the known exact solution. It is demonstrated that a single coupled state and resonance in elastic Vθ scattering arise simultaneously in the case of strong coupling. This effect is a characteristic field effect and does not hold for potential interaction. Some other features of Vθ scattering are also indicated. (auth)

48299 GEDANKEN EXPERIMENTS INVOLVING HADRONS. Susskind, L. (Yeshiva Univ., New York). Phys. Rev. Lett., 21: 944-5(Sept. 23, 1968).

A class of possible experiments which are not of the asymptotic scattering type are described. Use is made of the Einstein time dilatation to slow down the internal processes of an hadronic system so that it may be probed at controllable times. (auth)

48300 GEOMETRIC TEST OF THE ISOTOPIC INVARIANCE OF ELEMENTARY PARTICLES. Grishin, V. G.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 379-81(Aug. 1968). (In Russian).

Possible experiments to test the isotopic invariance of the strong interactions of elementary particles are considered. (J.F.P.)

Strong (Baryon No. = 0)

Refer also to abstracts 48289 and 48360.

48301 (JINR-E-2-3989) METHOD OF CONSTRUCTION OF THE ELASTIC SCATTERING APPROXIMATE AMPLITUDE. Isaev, P. S.; Popov, Kh. D.; Zlatev, I. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 29p. Dep.

A method is suggested for constructing the elastic meson scattering amplitude, satisfying, in all three channels, the exact conditions of analyticity, crossing symmetry, and two-particle unitarity near the physical threshold and an approximate unitarity condition on the cut. The analyticity properties of partial amplitudes are considered. It is shown that the dynamics of the scattering process are defined by the singularities lying on the unphysical sheet. (auth)

48302 S- AND P-WAVE $\pi\pi$ PHASE SHIFTS AT LOW ENERGIES. Gore, Bryan Frank. Ann Arbor, Mich., Univ. of Michigan, 1967. 73p.

Thesis.

An inverse amplitude calculation is performed assuming analyticity, elastic unitarity and approximate crossing symmetry. Seven parameters are introduced into the calculation. Five of these are fixed by crossing symmetry and two by requiring a p-wave resonance of mass 753 MeV with a width of 110 MeV. Computations are iterated by computer. Five parameterizations are investigated and eight solutions are found belonging to three of them. Only one solution is acceptable due to the presence of poles of the amplitude on the physical sheet. Both s-wave phase shifts drop from threshold. The decrease of these phase shifts at the ρ mass is 65° for I = 0 and 40° for I = 2. The p-wave phase shift is similar to the usual resonant behavior but does not approach 180° as rapidly. Scattering lengths are $\mu a_0^0 = -0.69 \pm 0.04$, $\mu a_0^2 = -0.37 \pm 0.03$ and $\mu^3 a_1^1 = 0.028$. (Disser. Abstr.)

48303 WEINBERG SUM RULES FOR ONE-PARTICLE MATRIX ELEMENTS. Pocsik, G. (Roland Eoetvoes Univ., Budapest). Nucl. Phys., B7: 30-6(1968).

Starting from the equality of the Schwinger terms in the vector current commutator and the axial-vector current commutator, new sum rules are derived. The sum rule containing only the isotriplet contributions is evaluated in an infinite-momentum limit. The result imposes a restriction for the parameters of the decays $\rho \to 2\pi$ and $A_1 \to \rho\pi$, from where reasonable values of the ρ, A_1 widths and the charge radius of the pion follow. (auth)

48304 FORMULATION OF A NONLOCAL THEORY BASED ON DE SITTER SPACE AND APPLICATION OF THE MODEL TO ELEMENTARY PARTICLES. Wataghin, Gleb Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 43: 154-7(Sept.-Oct. 1967). (In Italian).

A nonlocal theory of a particle composed of "quarks" is studied using the example of a π-meson. A De Sitter metric is introduced in the four-momentum space and a simple approximate equation for the interaction of two quarks is proposed and solved. (auth)

48305 CURRENT-FIELD IDENTIFICATION AND SCHWINGER TERMS. Burnel, A. (Univ., Liege). Nucl. Phys., B7: 91-6 (1968).

Schwinger's chiral dynamics scheme is used to compare the vector current Schwinger terms with those of the ρ-field in the limit of massless pions. Handling carefully the Lehmann-Källén representation, a value for the ρ coupling constant in good agreement with experiment is obtained. The method used here is not applicable to the axial current A_1-field identification. (auth)

48306 POSSIBILITY OF BARYON–ANTIBARYON ENHANCEMENTS WITH UNUSUAL QUANTUM NUMBERS. Rosner, Jonathan L. (Tel-Aviv Univ., Israel). Phys. Rev. Lett., 21: 950-2 (Sept. 23, 1968).

Arguments are presented in favor of B = 0 enhancements in the $\underline{10}$, $\underline{10}^*$, and $\underline{27}$ representations of SU(3) which decay mainly into a baryon and an antibaryon. (auth)

48307 SUM RULES FOR f_K/f_π AND m_κ AND THE WIDTH OF κ. Young, Bing-lin (Indiana Univ., Bloomington). Nuovo Cim., 57A: 415-19(Sept. 21, 1968).

A technique which combines with spectral-function sum rules and unsubtracted dispersion relations is used to obtain sum rules relating f_K/f_π, f_κ/f_π, m_κ and $g_{\kappa K\pi}$ and solutions to these quantities. (L.B.S.)

48308 $\pi\pi$ INTERACTION IN STATES WITH I = 2. Fil'kov, L. V. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 149-53(July 1968). (In Russian).

Integral relations between the imaginary parts of the $\pi\pi$ scattering amplitudes with different values of the isospin are obtained. The $\pi\pi$ interaction in states with I = 2 is studied. (auth)

48309 DISPERSION RELATION CALCULATION OF THE REAL PART OF THE FORWARD pp AND $\bar{p}p$ SCATTERING AMPLITUDE IN THE HIGH-ENERGY REGION. Bialkowski, G. (CERN, Geneva); Pokorski, S. Nuovo Cim., 57A: 219-27(Sept. 21, 1968).

Dispersion relation calculations of the real part of the forward pp scattering amplitude are presented. The results show that the energy dependence of the ratio Re f/Im f is in fact weaker than that obtained in earlier papers and also weaker than that which follows from the analysis of Coulomb interference term. Results for $\bar{p}p$ scattering are presented too, and these do not differ from what was known before. (auth)

48310 STUECKELBERG FIELDS AND CURRENT-ALGEBRA SUM RULES. Santhanam, T. S. (Inst. of Mathematical Sciences, Madras). Nuovo Cim., 57A: 440-1(Sept. 21, 1968).

A plausible derivation of the current-algebra sum rule $F_\rho^2 \rightarrow 2m_\rho^2 F_\pi^2$ is given using Stueckelberg fields. It is shown that not only are symmetry-breaking terms needed in Weinberg's second sum rule, but also in the first sum rule if the observed ratio $F_K/K_\pi = 1.28$ has to be accounted for. (L.B.S.)

48311 RESTRICTIONS ON SU(3) MIXING IMPLIED BY EXCHANGE DEGENERACY. Chiu, C. B.; Finkelstein, J. (CERN, Geneva). Phys. Lett., 27B: 510-12(Sept. 16, 1968).

It is shown that the hypothesis that the imaginary parts of exchanged Regge contributions must cancel in channels which contain no resonances implies restrictions on the way in which SU(3) may be mixed and broken in the vector and tensor meson nonets; for example, the mixing angle should satisfy $\tan^2 \theta = \frac{1}{2}$. (auth)

48312 LOW ENERGY $\pi\pi$-PHASE SHIFTS FROM COULOMB INTERFERENCE. Biswas, N. N.; Cason, N. M.; Johnson, P. B.; Kenney, V. P.; Poirier, J. A.; Shephard, W. D.; Torgerson, R. (Univ. of Notre Dame, Ind.). Phys. Lett., 27B: 513-17(Sept. 16, 1968).

The $\pi\pi$ s-wave phase shifts in the I = 2 state, δ_0^2, and I = 0 state, δ_0^0, was determined at low $\pi\pi$ masses by looking at interference between nuclear and Coulomb amplitudes. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 48273, 48297, 48348, and 48373.

48313 (CERN-68-23(Vol.2), pp 431-96) THREE LECTURES ON BARYON RESONANCES. Ferro-Luzzi, M. (CERN, Geneva).

The first lecture treats the hyperon resonances. Production and formation experiments, partial wave decomposition, and the Breit-Wigner resonance formula are discussed. The second lecture deals with the partial wave analyses of the KN and πN systems. Applications to SU(3) are considered in the third lecture. (L.B.S.)

48314 (CERN/ECFA-67/16(Vol.3)) ECFA: EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS. UTILIZATION STUDIES FOR A 300 GeV PROTON SYNCHROTRON. (European Organization for Nuclear Research, Geneva (Switzerland)). May 30, 1967. 167p. Dep.

Computer calculations of the kinematics for pp, Kp, and πp interactions and π, K, Λ, Σ, and Ξ decays are presented. The data are compiled for future use with the 300-GeV proton synchrotron. (L.B.S.)

48315 THE RELATIVISTIC SCHROEDINGER EQUATION AND ITS APPLICATION TO PSEUDOSCALAR MESON BARYON SCATTERING IN A BROKEN SU(3) SYMMETRY MODEL. Katz-Masson, Jose. Urbana, Ill., Univ. of Illinois, 1967. 264p.

Thesis.

The problem of pseudoscalar meson-baryon scattering is discussed within the framework of the relativistic Schrödinger equation and in the four lowest partial waves. The driving force (potential) is obtained by calculating the allowed single particle exchange processes for which the exchanged particles have spin less than or equal to $\frac{3}{2}$. The on-shell potential is obtained using Feynman's rules with coupling constants assumed to be related by SU(3), and actual experimental masses are used for both the exchanged and incoming or outgoing particles. The potential is then extrapolated off shell and the coupled system of linear integral equations for the scattering amplitude is solved numerically. In some of the cases under consideration the potential is such that a non-Fredholm system of integral equations is obtained. In these cases a cutoff is introduced to convert them into a Fredholm system which can then be solved numerically. Phase shifts are then computed and compared with experiment. Other techniques of calculating scattering amplitudes are reviewed and their predictions compared with those obtained by solving the relativistic Schrödinger equation. Some emphasis is placed on the Blankenbecler-Sugar equation and its relation to the relativistic Schrödinger equation, the formal properties of which are also reviewed. The solutions to the relativistic Schrödinger equation and the Blanckenbecler-Sugar equation and their dependence on different ways of extrapolating the potential off shell or introducing a cutoff are also discussed with examples. The model accounts for most of the experimentally known baryon resonances. (Diss. Abstr.)

48316 KINEMATICS OF MOMENTUM TRANSFERS IN MANY-BODY FINAL STATES. Lyons, L. (Nuclear Physics Lab., Oxford). Nucl. Phys., B7: 83-90(1968).

The kinematics of momentum transfers in many-body final states exhibit some surprising features. For example, the minimum momentum transfer from the beam to a final-state particle does not necessarily occur when the final-state particle travels forward with maximum momentum. Some implications of these properties relevant to reaction mechanisms are discussed. (auth)

48317 VACUUM EXCHANGES. Olsson, M. G. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Nuovo Cim., 57A: 420-4(Sept. 21, 1968). (COO-881-167).

The vacuum Regge exchange contribution to π-N scattering is investigated. It was previously shown that, in addition to P, a secondary trajectory P′ is required for consistency with a sum rule and to describe the decrease of the total cross-section sum $\Sigma_{\pi p} = \sigma_t(\pi^- p) + \sigma_t(\pi^+ p)$ to the Pomeranchuk limit. It is shown that the value of the P′ intercept depends on the method used to determine it indicating that a third singularity is present. Continuous moment sum rules are evaluated and applied to the vacuum exchange problem to investigate the role of the third pole, P″. (L.B.S.)

48318 NONLINEAR FUSION EQUATIONS. Bas'yuni, A. Kh.; Kurdgelaidze, D. F. (Moscow State Univ.). Yadern. Fiz., 8: 154-64(July 1968). (In Russian).

An equation of the Bargman-Wigner type for mesons and baryons is constructed proceeding from the nonlinear quark equation with the minimal nonlinearity. In the case of the mesonic field, the Yang-Mills nonlinear equation from the theory of compensating fields is obtained with some restrictions. In the case of baryons, the equations obtained are of the form of the Dirac equation for a fermion interacting with meson fields. Hence in SU(3) symmetry, correct values of magnetic moments of baryons of the octet ($\frac{1}{2}^+$) and of their couplings with mesons are obtained. The case of the SU(3) symmetry violation is also considered. (auth)

48319 POLARIZATIONS IN THE OVERLAP FUNCTION ANALYSIS OF $\pi^\pm$p ELASTIC AND CHARGE-EXCHANGE SCATTERING AT HIGH ENERGIES. Henzi, R. (CERN, Geneva). Nuovo Cim., 57A: 301-37(Sept. 21, 1968).

The results are presented on polarizations in $\pi^\pm p \rightarrow \pi^\pm p$ and $\pi^- p \rightarrow \pi^0 n$ high-energy scattering which follow from a recent overlap function analysis combined with dispersion relations. The calculated $\pi^- p \rightarrow \pi^0 n$ polarization is in agreement with present experimental results at 6 and 11 GeV/c. $\pi^\pm p \rightarrow \pi^\pm p$ polarizations at 6, 8, 10 and 12 GeV/c are fitted by adjusting an unknown, energy-independent function of t. For higher energies (up to about 25 GeV/c) the $\pi^- p \rightarrow \pi^0 n$ polarization is expected not to change qualitatively while for $\pi^\pm p \rightarrow \pi^\pm p$ an increasingly asymmetric behavior is found. Predictions for the Wolfenstein parameters A and R at present and higher energies are given. In the present scheme the $\pi^- p \rightarrow \pi^0 n$ polarization results from exchange of a ρ-meson Regge pole $\alpha = \alpha_\rho(t)$ supplemented by well-determined corrections of Regge-cut type. The part of the amplitude even under crossing is found to be composed of a fixed Pomeranchuk pole term $\alpha = 1$, a P′ pole term with cut corrections which is determined by the ρ term and has the same trajectory, and a Pomeranchuk daughter term with $\alpha = 0$ operating as ghost compensator for the P′ pole. (auth)

48320 MULTIPLE SCATTERING AND ISOBAR PRODUCTION. Frautschi, S.; Margolis, B. (CERN, Geneva). Nuovo Cim., 57A: 427-32(Sept. 21, 1968).

A multiple-scattering formalism is applied to isobar production process $p + p \rightarrow p + N^*$. The treatment provides an explanation of the momentum-transfer behavior of the cross section $d\sigma/dt$. Some further possible applications of the method are listed. (L.B.S.)

48321 ANALYSIS OF KN TOTAL CROSS SECTIONS WITH CONTINUOUS MOMENT SUM RULES. Fontan, C. Ferro (International Centre for Theoretical Physics, Trieste, Italy); Lusignoli, M.; Odorico, R.; Restignoli, M.; Violini, G. Nuovo Cim., 57A: 442-5(Sept. 21, 1968).

An attempt is made to extract the relevant Regge-pole parameters for the data of total KN cross sections, using continuous moment sum rules along with a technique applied previously to the πN case. (L.B.S.)

48322 SMALL-Δ^2 BEHAVIOR IN $\pi^- p \rightarrow \rho^0 n$ AT 8 GeV/c; CHEW-LOW EXTRAPOLATION AND CONSPIRACY EFFECTS. Selove, W. (Univ. of Pennsylvania, Philadelphia); Forman, F.; Yuta, H. Phys. Rev. Lett., 21: 952-6(Sept. 23, 1968).

Rho^0 production and decay are examined, particularly for $\Delta^2 < \mu^2$. The implications of the results regarding Chew-Low extrapolation procedure, and regarding a conspiracy interpretation, are discussed. (auth)

48323 REGGE CUTS, ABSORPTION MODEL, AND DIFFRACTION DIPS IN INELASTIC SCATTERING. Henyey, F.; Kane,

G. L.; Pumplin, Jon; Ross, Marc (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 21: 946-9(Sept. 23, 1968).

An expression is proposed for calculating Regge-cut contributions to inelastic scattering, based on the absorption model. A brief justification of the expression is presented, using the idea of an instantaneous composite structure for the scattering particles. The model is applied to ρ exchange in $\pi^-p \to \pi^0n$. (auth)

48324 CONSTRAINTS ON ASYMPTOTIC BEHAVIOR OF MESON–BARYON SCATTERING AMPLITUDE. Olsson, Martin G. (Univ. of Maryland, College Park. Univ. of Wisconsin, Madison); Yodh, Gaurang B. Phys. Rev. Lett., 21: 1022-5(Sept. 30, 1968).

Constraints of continuous moment sum rules as applied to the symmetric πN scattering amplitude are used to rule out all two-pole models for its asymptotic behavior. Two three-pole solutions are discussed having $\sigma(\infty)$ equal to 21 and 17 mb, respectively. (auth)

48325 LOCATION OF A SECONDARY ρ REGGE POLE IN THE REACTION $\pi^-p \to \pi^0n$. Barger, V. (Univ. of Wisconsin, Madison); Phillips, R. J. N. Phys. Rev. Lett., 21: 865-8(Sept. 16, 1968).

The trajectories and residues ρ and ρ' Regge poles are determined in the range $0 \geq t \geq -1.0$ $(GeV/c)^2$ from a simultaneous fit to (i) continuous-moment sum rules, using πN phase shifts up to 2 GeV/c, and (ii) $\pi^-\rho \to \pi^0n$ scattering cross section data above 4 GeV/c. The ρ' trajectory is found to be roughly parallel to the ρ and about a half-unit lower. The $\pi^-\rho \to \pi^0n$ polarization is correctly predicted in magnitude and sign. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 48257, 48309, and 48314.

48326 MODELS FOR THE PROCESS $p + p \to d + \pi^+$ AT 3 TO 13 GeV/c. Brown, D. J. (Carleton Univ., Ottawa). Nucl. Phys., B7: 37-46(1968).

The predictions of the one-pion-exchange and one-nucleon-exchange models are compared for the process $p + p \to d + \pi^+$ with experimental data for angular distributions at 2.8, 3.4, and 3.9 GeV incident energy, and for energy dependence at 180° for the deuteron in the c.m. system in the range 3-13 GeV/c. It is concluded that neither model is sufficiently successful. (auth)

48327 REGGE POLES AND NUCLEI. Faucher, G. (Laboratoire de Physique Generale, Paris). Nucl. Phys., B7: 16-18 (1968).

The Regge model is applied to high-energy proton-carbon scattering. The residues are evaluated from the experimental data and an estimate is given of their dependence on atomic number. (auth)

48328 REMARKS ON pΛ RESONANCE. Chand, Ramesh (Wayne State Univ., Detroit). Nuovo Cim., 57A: 413-15(Sept. 21, 1968).

It is pointed out that earlier multiple-scattering calculations, under the assumption of charge independence for coupled channel $\bar{K}NN - \pi YN$ nuclear interactions, predict an $I = \frac{1}{2}$, $J = 1$, $l = 0$, Σ-N bound state (ΛN elastic resonance) at $E_\gamma \simeq 2127$ MeV, and $\Gamma \simeq 20$ MeV. The predictions are found to be consistent with all the available experimental data on $K^-d \to \pi^-\Sigma N \to \pi^-\Lambda p$ reactions. (L.B.S.)

48329 THREE-BODY PROBLEM. K-HARMONICS METHOD IN THE PROBLEMS OF CONTINUOUS SPECTRUM. Zakhar'ev, B. N.; Pustovalov, V. V.; Efros, V. D. Yadern. Fiz., 8: 406-14 (Aug. 1968). (In Russian).

Scattering problem in the three-nucleon system is under consideration. The wave function is divided into two parts where one part describes correctly the two fragment asymptotics, and the other is searched as an expansion over six-dimensional angular functions forming the irreducible representation of the rotation group and of the permutation group. The expansion quickly converges, and a small number of harmonics is sufficient. A simple algorithm for finding the scattering amplitudes is presente Numerical calculations are performed for zero energy of the relative motion of neutron and deuteron. (auth)

48330 PROTON–NEUTRON INTERACTIONS IN THE ENERGY REGION 20 GeV. Takibaev, Zh. S.; Boos, E. G.; Tursunov, R. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz., 8: 354-9(Aug. 1968). (In Russian).

The results obtained at the treatment of 254 interactions emerging in the emulsion Ilford G-5 irradiated by 19.8-GeV/c protons, are considered. Angular and momentum spectra of secondary particles in the cms of colliding nucleons are analyzed. The inelasticity coefficient distribution is given for events with two identified protons. The parts of energy carried away by charged and neutral particles are estimated. Comparison with predictions of statistical theory and of the one-meson exchange model shows that the results obtained cannot be totally explained in terms of only one of the considered models. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 48471.

48331 (CERN-68-23(Vol.1), pp 235-364) HIGHER SYMMETRIES. Morales, A. (Univ. of Zaragoza, Spain).

Lectures devoted to the study of the SU(3) group and its experimental consequences are presented. The mathematical aspects of SU(3) are analyzed mainly through its Lie algebra. The unitary symmetry is then applied to strong, weak, and electromagnetic interactions. (L.B.S.)

48332 GRAPHICAL FORMULATION OF RECOUPLIN THEORY FOR ANY COMPACT GROUP. Agrawala, Vishnu K. (Point Park Coll., Pittsburgh); Belinfante, Johan G. Ann. Phys. (N. Y.), 49: 130-70(1968).

The general diagrammatic method for calculating and working with Racah and related coefficients is presented in its most general form. The discussion should be useful to all those who are interested in computing and using coupling techniques for any compact group. Unlike earlier treatments of diagram methods, the graphical equations presented are an exact transcription of algebraic relations involving 3-j, 6-j, 9-j, etc. coefficients, including all phase factors. (auth)

48333 SU(1,1) QUASI-SPIN FORMALISM OF THE MANY-BOSON SYSTEM IN A SPHERICAL FIELD. Ui, Haruo (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 49: 69-92(1968).

A new approach is developed to treat the many boson system in a spherical field, such as, for example, the nuclear many surface phonon state. This approach is a generalization of the SU(2) quasi-spin formalism for fermion systems to the noncompact SU(1,1) group for boson systems. It is shown that the pair creation, pair destruction, and number operators form a Lie algebra of the SU(1,1) group and that the wave function $|^n$ v LM) of n bosons with seniority v constitutes a two-valued projective representation of the SU(1,1) group. The transformation properties of tensor operators in the SU(1,1) quasi-spin space are examined in detail; the Wigner–Eckart theorem is established for the matrix elements of a tensor operator between the unitary representations of the SU(1,1) group. A new kind of Wigner coefficient of the SU(1,1) group is obtained which couples unitary and nonunitary representations to get a unitary representation. Algebraic formulas of this Wigner coefficient are derived; this coefficient is proved to be an analytic continuation of the Clebsch–Gordan coefficient of the SU(2) group. Since the particle number, n, appears only in the projective quantum numbers of this formalism, the n-dependence of any matrix element can be separated entirely into that of the Wigner coefficient alone; thus, n-boson problem reduces directly to a v-boson problem. (auth)

48334 ON A POSSIBLE APPROACH TO THE VARIABLE-MASS PROBLEM. Fushchick, V. I. (Inst. of Mathematics, Kiev); Krivskii, I. Yu. Nucl. Phys., B7: 79-82(1968).

The mass operator M is introduced as an independent dynamical variable which is taken as the translation generator P_4 of the inhomogeneous De Sitter group. The classification of representations of the algebra P(1,4) of this group is performed and the corresponding P(1,4) invariant equations for variable-mass particles are written out. In this way the "external" and "internal" (SU_2) symmetries were united in a nontrivial fashion. (auth)

48335 DECOUPLED AND COVARIANTLY REDUCED RELATIVISTIC FADDEEV EQUATIONS. Namyslowski, J. M. (Stanford Univ., Calif.). Nuovo Cim., 57A: 355-81(Sept. 21, 1968).

The relativistic three-body equations for particles with spin 0, $\frac{1}{2}$ and their bound states are decoupled, written in a form with no potentials in them, and covariantly reduced. The reduction procedure is formulated in terms of the Wightman–Gårding relative momenta, which enable us to obtain the correct off-shell continuation in the total energy, leaving the relative energies zero, for arbitrary masses. Thus, it is possible to maintain appropriate time-reversal invariance both in two-body and three-body systems. The partial-wave decomposition and the separable approximation are discussed in full detail. (auth)

48336 CONSTRUCTION OF INVARIANTS FOR LIE ALGEBRAS OF INHOMOGENEOUS PSEUDO-ORTHOGONAL AND PSEUDO-UNITARY GROUPS. Rosen, Joe (Brown Univ., Providence). J. Math. Phys. (N. Y.), 9: 1305-7(Aug. 1968). (NYO-2262TA-164).

A method of constructing invariants for the Lie algebras of the inhomogeneous pseudo-orthogonal and pseudo-unitary groups from invariants of the (homogeneous) pseudo-orthogonal and pseudo-unitary groups, respectively, is presented. The method is based on the "expansion" (or "deformation") of the inhomogeneous algebras to homogeneous ones. Several examples are worked out. (auth)

48337 QUASIBINOMIAL REPRESENTATIONS OF CLEBSCH-GORDAN COEFFICIENTS. I. SQUARE SYMBOL. Ansari, S. M. Razullah (Univ., Tuebingen, Ger.). J. Math. Phys. (N. Y.), 9: 1294-9(Aug. 1968).

Quasibinomial representation of Clebsch–Gordan coefficients is symbolized by a Regge-like square. Rules for exchange of rows and columns of this square are derived. Thus our various quasibinomial forms can be read off from this square directly. (auth)

48338 QUASIBINOMIAL REPRESENTATIONS OF CLEBSCH-GORDAN COEFFICIENTS. II. "NEGATIVE" REPRESENTATIONS. Ansari, S. M. Razaullah (Univ., Tuebingen, Ger.). J. Math. Phys. (N.Y.), 9: 1299-1305(Aug. 1968).

New quasibinomial forms are derived from the quasibinomial forms given previously by making use of both positive and negative generalized powers. They turn out to be a new representation of the Wigner-type unsymmetric formulas of Clebsch–Gordan coefficients for angular momenta. Consequently, formulas of Racah, Majumdar, and Shimpuku are deduced as special cases. Rules to construct a square symbol are given from which all these "negative" quasibinomial representations or, more precisely, expansions can be read off directly. Thus, a unified treatment of both symmetrical and unsymmetrical formulas of Clebsch–Gordan coefficients is thereby accomplished. (auth)

48339 "LORENTZ BASIS" OF THE POINCARE GROUP. Chakrabarti, Amitabha; Levy-Nahas, Monique; Seneor, Roland (Centre de Physique Theorique de l'Ecole Polytechnique, Paris). J. Math. Phys. (N. Y.), 9: 1274-83(Aug. 1968).

An explicit derivation is given for the matrix elements of the translation generators P_μ of the Poincaré algebra with respect to the "Lorentz basis", namely, in terms of states which diagonalize the two Casimir operators of the homogeneous Lorentz group (HLG). The results are given for the cases mass $\mu > 0$ and $\mu = 0$ and, for the latter, for discrete and continuous spin. The transforms connecting the momentum and Lorentz bases are discussed, a detailed derivation being given for the zero-mass discrete-spin case. The matrix elements of $G_\mu = i[(N^2 - M^2), P_\mu]$ are considered and several interesting aspects of the algebras generated by N, M', and $P'_\mu = (\epsilon_1 P_\mu + \epsilon_4 G_\mu)$ are discussed for the cases of positive as well as zero rest mass. (auth)

48340 DEGENERATE REPRESENTATIONS OF THE SYMPLECTIC GROUPS. I. THE COMPACT GROUP Sp(n). Pajas, P.; Raczka, R. (International Atomic Energy Agency, Trieste, Italy). J. Math. Phys. (N. Y.), 9: 1188-1201(Aug. 1968).

The degenerate, irreducible, unitary representations of the compact group Sp(n), characterized by one and two invariant numbers, are considered. The explicit expressions for the basis functions spanning the corresponding representation spaces and the decomposition with respect to the maximal subgroup are given. (auth)

48341 FIRST ORDER DEFORMATIONS OF LIE ALGEBRA REPRESENTATIONS, E(3) AND POINCARE EXAMPLES. Levy-Nahas, Monique; Seneor, Roland (Ecole Polytechnique, Paris). Commun. Math. Phys., 9: 242-66(1968).

A classification of "first order" deformations of Lie algebra representations by the use of a cohomology group is studied. A method is proposed for calculating this group for the case of algebras which are semi-direct products. The role of unitarity of the representations is exhibited. Applications are made for the Poincaré and E(3) algebras. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 48214, 48266, and 48288.

48342 (CERN-68-23(Vol.2), pp 497-521) PHENOMENOLOGY OF CP VIOLATION IN K^0 DECAYS. Iliopoulos, J. (CERN, Geneva).

The superposition principle and superselection rules are discussed. The phenomenology of the K^0–$\bar{K}^0$ system is then considered. The topics discussed include the mass matrix, unitarity relations, TCP relations, eigenstates of long and short-lived kaons, and phenomenology of CP violation. (L.B.S.)

48343 (COO-1195-136) STATUS OF EXPERIMENTAL SEARCHES FOR CP VIOLATION IN OTHER THAN NEUTRAL K-DECAYS. Wattenberg, A. (Illinois Univ., Urbana. Dept. of Physics). July 1968. Contract AT(11-1)-1195. 11p. Dep. CFSTI.

A review is given of the experimental searches for CP or T violation in interactions other than K^0 decays, with emphasis on the τ decays. Previous works as well as experiments planned or in progress are tabulated. (L.B.S.)

48344 TEST OF CPT INVARIANCE. Okun, L. B. Comments Nucl. Particle Phys., 11: 116-24(July-Aug. 1968).

The consequences of CPT invariance which can be tested experimentally are discussed. Relations between decays of particles and antiparticles and CPT invariance in K^0 decays are discussed in detail. Some remarks on the meaning of CPT violation are given. (L.B.S.)

48345 MULTIPLET MASS DIFFERENCES. Low, Francis E. Comments Nucl. Particle Phys., 11: 111-15(July-Aug. 1968).

The mass difference between two different members of a multiplet is considered as the most striking and most easily measurable violation of isotopic-spin conservation. Some of the ideas and problems that are involved in attempts to calculate this mass difference are discussed. (L.B.S.)

48346 COMPARISON OF THE K^+ AND K^- DECAY RATES INTO THE τ AND K_{μ_2} MODES. Ford, William T. Princeton, N. J., Princeton Univ., 1967. 142p.

Thesis.

In an experiment at the Brookhaven AGS the decay rates of charged K mesons into the τ mode ($K^\pm \to \pi^\pm\pi^+\pi^-$) were measured in order to test the equality of the τ^+ and τ^- rates. A difference between these rates would constitute a violation of CP invariance. At the same time the K^+ and K^- decay rates into the K_{μ_2} mode ($K^\pm \to \mu^\pm\nu_\mu$) were also compared, as a test of CPT invariance. The K mesons, identified with a Cherenkov counter, were allowed to decay in flight over a well-defined region at the end of which were detectors for the charged secondaries. To detect the τ decays an array of eight triangular scintillation counters arranged in an octagon was used, with the requirement that all three pions give a count. A second bank of counters placed behind an iron absorber detected the muons from K_{μ_2} decays. The result for the ratio of τ^+ and τ^- decay rates is $(\Gamma_+/\Gamma_-)_\tau - 1 = -0.0004 \pm 0.0021$, consistent with CP invariance. The absolute τ decay rate is $\Gamma_\tau = (4.496 \pm 0.030) \times 10^6\ \text{sec}^{-1}$. For K_{μ_2} decay the result of the rate comparison is $(\Gamma_+/\Gamma_-)_{\mu_2} - 1 = -0.0054 \pm 0.0041$, in agreement with zero, as predicted by CPT invariance. (Disser. Abstr.)

48347 MESON PHOTOPRODUCTION ON NUCLEONS, REGGE POLES, AND SU(3) SYMMETRY. Rekalo, M. P. Yadern. Fiz., 8: 138-48(July 1968). (In Russian).

Photoproduction of pseudoscalar and neutral vector mesons on nucleons at high energies and small momentum transfer is considered in framework of the Regge-pole model. To reduce the number of independent Regge-pole couplings to mesons and baryons, the SU(3) symmetry and the degeneracy of vector and tensor Regge poles are used. Relations between the differential cross sections of π^+- and K^+-meson photoproduction on protons, as well as the behavior of the differential cross section of the reaction $\gamma + p \to p + \pi^0$, predicted by the model, are in good agreement with the experimental data. Analyzing the spin structure of the pseudoscalar meson photoproduction amplitude, one can show that the main contribution to the cross section at nonvanishing meson-production angles is from the spin–nonflip amplitudes. This allows one to predict a deep minimum in the $\gamma + p \to \Sigma^0 + K^+$ differential cross section under the zero angle. A number of predictions are obtained for the photoproduction of mesons with baryonic resonances. For the photoproduction of neutral vector mesons on neutrons, the predictions of the Regge-pole model are different from those of the quark model. (auth)

Applications (Strong)

Refer also to abstract 48315.

48348 SU(6) INVARIANCE IN S-WAVE MESON BARYON SCATTERING. Carey, David Crockett. Ann Arbor, Mich., Univ. of Michigan, 1967. 91p.

Thesis.

SU(6) was incorporated into a simple model of a multichannel amplitude for s-wave scattering of mesons in the 35 representation by baryons in the 56. Symmetry breaking is introduced by making the amplitude satisfy unitarity exactly in the direct

channel. The contributions to the amplitude from the crossed channel singularities are assumed to be SU(6) invariant and can be expressed in terms of the product of four scattering lengths times appropriate projection matrices. Fits of the model were made to the threshold parameters of πN, KN, and $\bar{K}$N scattering. Several solutions were found and a comparison of calculated threshold parameters, cross sections and phase shifts with experimental data is made. Calculations of resonances predicted by the model are performed and found to be in good agreement with experimental results. (Disser. Abstr.)

48349 STUDY OF A THEORY OF NONSTRANGE MESONS. Cambefort, Jean-Louis (Faculte des Sciences, Dijon, France). Compt. Rend., Ser. A and B, 267: 172-5(July 15, 1968). (In French).

The point of departure for the theory is the choice of an internal space I, whose motion group is $0(4) \times R$. One can interpret the mass spectrum of mesons as that of proper values of the Laplace–Beltrami operator. The external space is the four-dimensional Minkowski space, whose motion group is the Poincaré group P. The state of a particle is determined as a function of internal and external variables. If the latter are independent, and if the total space considered is the product of partial spaces, there is no coupling between the internal and external properties. (J.F.P.)

Field Theories

Quantum Field Theory

48350 (CERN-68-23(Vol.1), pp 1-128) TOPICS IN ADVANCED QUANTUM MECHANICS AND FIELD THEORY. Galindo, A. (Univ., Madrid).

Some basic facts on the Poincare transformations as symmetry operations are reviewed, with special emphasis on the relativistic elementary systems. The relativistic wave equations for free scalar, spin $\frac{1}{2}$, and vector particles are briefly described. The S-matrix description of reaction and decay processes is discussed and some important formulas for cross sections and partial lifetimes are deduced. The techniques of quantized fields, local interactions, and Feynman graphs are outlined. Four Appendices are included, which recollect some elementary facts on the Poincaré group, gamma matrices, Fock space techniques, and some useful formulas for two-body phase space integrals. (L.B.S.)

48351 (IFVE-STF-68-7-K) THEORY OF A FIELD IN THE DISCRETE SPACE. Leznov, A. N. (Institut Fiziki Vysokikh Energii, Serpukhov (USSR)). 1968. 5p. (In Russian). Dep.

The general method to derive wave equations in the discrete space-time is formulated. (auth)

48352 FUNDAMENTAL THEOREM ON THE RELATION BETWEEN SPIN AND STATISTICS. Sundarshan, E. C. G. (Syracuse Univ., N. Y. Univ. of Delhi). Proc. Indian Acad. Sci., Sect. A, 67: 284-93(May 1968).

The fundamental theorem on the connection of spin and statistics is deduced from the basic symmetry between emission and absorption processes in quantum field theory. The new theorem which prescribes the physical connection of Bose fields with integral spin and Fermi fields with half-integral spin, is valid for all field theories; and it contains Pauli's theorem as a special case. (auth)

48353 LIE GROUPS AND QUANTUM MECHANICS. Simms, D. J. Lecture Notes in Mathematics. Volume 52. Berlin, Springer-Verlag, 1968. 96p. DM 8,--; $2.00.

An account is given of the ideas which arise from the concept of relativistic invariance in quantum mechanics. The material is presented in a form which uses standard concepts from other areas of mathematics. Relativistic invariance, lifting projective representations, the relativistic free particle, Lie algebras and physical observables, universal enveloping algebra and invariants, and induced representations are covered. Also covered are representations of semi-direct products, classification of the relativistic free particles, the Dirac equation, and charge and isospin in SU(3) symmetry. (J.F.P.)

48354 DEFINITION OF THE DIRAC ISOTOPIC CURRENT OPERATOR IN YANG–MILLS THEORY. Kannenberg, L.; Arnowitt, R. (Northeastern Univ., Boston). Ann. Phys. (N. Y.), 49: 93-105(1968).

The isotopic current operator for a Dirac field in the presence of an external Yang–Mills field is examined. The current is viewed as the limit of a well-defined operator where the points at which the Dirac fields are evaluated have been separated infinitesimally and appropriate line integrals inserted to maintain the correct gauge transformation properties. It is shown that the matrix elements of the current operator then obey the correct conservation law to arbitrary order in the Yang–Mills field as the separation between the Dirac field points limits to zero. (auth)

48355 VACUUM POLARIZATION IN AN OSCILLATORY GAUGE. Yock, P. C. M. (Univ. of Auckland, New Zealand). Nuovo Cim., 57B: 154-60(Sept. 11, 1968).

The fourth-order contribution to charge renormalization is calculated in an infinitesimally oscillatory gauge, and the result is discussed in its relation to the possible finiteness of vacuum polarization. The special gauge used is found to provide a natural means for maintaining simultaneous consistency with Ward's identity and the spectral representation of the electron propagator. (auth)

48356 WHAT IS WRONG WITH RELATIVISTIC KINEMATICS. Cantoni, V. (Univ., Rome). Nuovo Cim., 57B: 220-3(Sept. 11, 1968).

It is shown on purely kinematical grounds that one of the assumptions implicitly contained in the statement of Ehrenfest's paradox is not correct. The assumption is that the geometry of Minkowski space–time allows the passage of the disk from rest to rotation in such a fashion that both the length of the radius and the length of the periphery, measured with respect to the comoving frame of reference remain unchanged. It is shown that a careful definition of all the quantities involved eliminates the paradox and with it the alleged inconsistency of relativistic kinematics. (J.F.P.)

48357 ANGULAR MOMENTUM IN FIELD THEORY. Marx, E. (Drexel Inst. of Tech., Philadelphia). Nuovo Cim., 57B: 43-61(Sept. 11, 1968).

A discussion of a separation of the total angular momentum into spin and orbital parts is presented in terms of the relation of the latter to a position operator for quantized fields. (auth)

48358 TROUBLE WITH THE SELF-CONSISTENT FIELD THEORY OF QUANTUM ELECTRODYNAMICS. Mann, R. A. (Univ. of Dayton, Ohio). Nuovo Cim., 57B: 77-82(Sept. 11, 1968).

The Lamb-shift measurements are analyzed within the framework of the self-consistent spinor field theory of quantum electrodynamics developed several years ago. It is found that the theory predicts a substantial dependence of the shift on the applied Zeeman field and this is in conflict with the experimental results. (auth)

48359 MODEL FOR THE REPRESENTATION OF FUNDAMENTAL PARTICLES AND THE QUANTUM THEORY OF ASSOCIATED FIELDS. Petiau, Gerard (CNRS, Paris). Compt. Rend., Ser. A and B, 267: 169-71(July 15, 1968). (In French).

A study is made of a model for a description of the fundamental particles by means of a nonlinear theory in which the quantization of the self masses results in the quantization of the field amplitudes. (tr-auth)

48360 ON THE CHECK OF LINEARITY OF THE QUANTUM ELECTRODYNAMICAL EQUATIONS IN SOME EXPERIMENTS AT HIGH ENERGIES. Geshkenbein, B. V.; Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 119-28(July 1968). (In Russian).

It is shown that existing experiments on the check of the quantum electrodynamics do not exclude the possibility that in the electromagnetic field Lagrangian there are terms $(1/4m_a^4)(E^2 - H^2)^2$ and $(1/4m_b^4)(2EH)^2$ (m_a, m_b are the constants with the mass dimension), i.e., there exists a weak nonlinearity of the field equations. From the data on the factor $(g - 2)$ for μ meson one has restrictions on m_a and m_b: $m_a \sim m_b \gtrsim 1$ GeV. These anomalous interactions (if they exist) must appear in experiments at high energies. If $m_a \sim m_b \sim 1$ GeV, then: (1) the process γ + nucleus $\rightarrow 2\gamma$ + nucleus at the energy of incident photon ~10 GeV has the cross section $\sim 10^{-29} \div 10^{-30}$ cm^2; (2) the cross section of the 3γ proton–antiproton annihilation at the energy of the order of several GeV's in cms is of the order of the $p\bar{p} \rightarrow e^+e^-$ annihilation; (3) in the processes $e^+e^- \rightarrow 2\gamma$ and $e^+e^- \rightarrow 3\gamma$ at the energy 1 GeV in cms considerable (from 10 up to 100%) deviations from the quantum electrodynamical predictions must be observed. Possibilities of existence and the effects from CP and P odd interactions ~EH $(E^2 - H^2)$ are considered. If this interaction is responsible for the $K_2 \rightarrow 2\pi$ decay, then at the energies of the order of several GeV's, large (100%) effects of CP and P violation must be observed in some radiation processes. (auth)

48361 ON THE CONNECTION BETWEEN THE T-MATRIX AT ZERO MOMENTA AND THE CLASSICAL LAGRANGIAN. Prokhorov, L. V. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 57A: 245-52(Sept. 21, 1968).

The connection between the classical Lagrange function de-

scribing correctly low-energy quantum field theory scattering phenomena and the T-matrix at zero momenta is investigated. (auth)

48362 RELATIVISTIC FIELDS WITH SPACELIKE MOMENTUM SPECTRA AND ISOSPIN. Abdel-Rahman, A-M. M.; Bloore, F. J. (Univ. of Liverpool). Nuovo Cim., 57A: 425-6(Sept. 21, 1968).

It is pointed out that scalar fields which are self-conjugate multiplets of isospin T and which have spacelike momentum spectra, commute at all separations if T is an integer, and do not commute at any separations if T is a half-integer. (L.B.S.)

48363 TIME-ORDERED PRODUCTS IN TWO-DIMENSIONAL FIELD THEORIES. Challifour, John L. (Brandeis Univ., Waltham, Mass.). J. Math. Phys. (N. Y.), 9: 1137-45(Aug. 1968).

It is shown that the vacuum expectation values (VEV) of $:e^{\lambda\sigma}:(t,f) = \int dx f(x) :e^{\lambda\sigma}:(t,x)$ are continuous functions of the time for test functions which are C^∞ and of rapid decrease, with λ in some neighborhood of the origin in the complex plane. The field $\sigma(x)$ is the pseudopotential derived from the pseudovector current of a free two-component massive field in two-dimensional space-time. A consequence of this result is the existence of Green's functions in the Federbush model. An essential technique in the proof is a theorem by Jaffe on the boundary values of limits of sequences of analytic functions. (auth)

48364 RENORMALIZATION OF THE FIELD OPERATOR IN AXIOMATIC FIELD THEORY. Medvedev, B. V.; Polivanov, M. K.; Sukhanov, A. D. (Mathematics Inst., Moscow). Zh. Eksp. Teor. Fiz., 55: 512-29(Aug. 1968). (In Russian).

It is demonstrated that field renormalization within the framework of the axiomatic approach does not reduce to multiplication of the field, current or charge by certain numerical factors. The latter are in fact integro-differential operators which are different on and outside the energy shell. Only at the expense of such specific peculiarities does it become possible to satisfy the solvability condition in renormalized theory. The spectral representations are defined more accurately. In particular one-particle contributions to the spectral density (in the presence of subtractions) are consistently taken into account on basis of the unitarity condition. The apparatus developed permits one to relate the two traditional methods of introduction of renormalization constants, the Hamiltonian method and Lehman axiomatic method. It is shown that the formulas for the Heisenberg operators themselves correspond to those for their vacuum expectation values in the nonrenormalized, as well as in the renormalized theory. (auth)

48365 ANALYTICAL CONTINUATION ON THE COUPLING CONSTANT IN A MODEL OF NONRENORMALIZABLE FIELD THEORY. Arbuzov, B. A.; Atakishiev, N. M.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 385-91(Aug. 1968). (In Russian).

A method for construction of the exact solution of the Dyson equations in the nonrenormalizable theory of spinor and scalar fields with the interaction $\mathscr{T}_{int} = g\bar{\psi}\gamma_n\psi\partial^n\varphi$ is proposed. The method is based on the analytical continuation on the coupling constant g which makes it possible to obtain solutions exponentially increasing at infinitely large momenta. (auth)

48366 SUFFICIENT CONDITION FOR A NONZERO-MASS VECTOR-FIELD THEORY TO BE RENORMALIZABLE. Slavnov, A. A. (Mathematics Inst., Moscow). Yadern. Fiz., 8: 392-5 (Aug. 1968). (In Russian).

A sufficient condition for a nonzero-mass vector-field theory to be renormalizable is obtained. This condition makes the known until now class of renormalizable theories wider. (auth)

48367 ON THE PROBLEM OF S-MATRIX UNITARITY IN FIELD THEORIES WITH DERIVATIVES. Medvedev, B. V.; Polivanov, M. K.; Sukhanov, A. D. (Mathematics Inst., Moscow). Yadern. Fiz., 8: 396-405(Aug. 1968). (In Russian).

The unitarity of the S matrix is investigated in a model of bilinear interaction with derivatives. The wave function is renormalized by this means. The T_W exponent of the Hermitian $\mathscr{T}_1(x)$ is shown to be nonunitary. The unitary S matrix is constructed with a given Hermitian current. An expression for the S matrix is obtained as a normal exponent. (auth)

48368 CERTAIN DYNAMICAL INVARIANCE IN QUANTUM FIELD THEORY. Razavy, M. (Univ. of Alberta, Edmonton). Can. J. Phys., 46: 1827-34(Aug. 15, 1968).

The invariance of the equation of motion of classical fields under a certain type of transformation which is inversely proportional to the coupling constant is studied. A model of a nonlinear self-interacting boson field with this kind of invariance is constructed and then quantized. The vertex function in the lowest order of the N-quantum approximation is obtained, and it is shown that without a cutoff this invariance is not preserved. As a second example, a special form of the scale transformation is applied to the equations of motion of an electron interacting with the electromagnetic field. It is shown that the vacuum state of the transformed electromagnetic field is different from the original vacuum state and that these vacuum states are orthogonal to each other. For this problem, the perturbative technique for the solution of the quantized fields leads to the breakdown of the invariance. (auth)

Gravitation and General Relativity

48369 GENERAL RELATIVISTIC FLUID SPHERES. II. SOLUTIONS OF THE EQUATION FOR $e^{-\lambda}$. Kuchowicz, B. (Univ. of Warsaw). Acta Phys. Pol., 34: 131-40(July 1968).

New exact solutions of the gravitational field equations are derived. These solutions describe static and spherically symmetric distributions of a perfect fluid; they may prove useful in a model description of relativistic stars. In the first part of this paper (Kuchowicz 1968a) solutions have been derived in a way which started from some simple assumptions on the metric tensor component $e^{-\lambda}$. Now similar procedure is developed with an initial assumption on the function e^{ν}. (auth)

48370 AN IMPROVED THEORY OF GRAVITATION. II. Rastall, P. (Univ. of British Columbia, Vancouver). J. Phys., A (London), 1: 501-19(Sept. 1968).

The theory of gravitation of a previous paper (Rastall, Can. J. Phys. 1968) is presented in a deductive and more rigorous form. The assumptions made about the space–time metric, the scalar gravitational potential and the special (Newtonian) charts are summarized. An action principle is stated, and the conservation laws of energy–momentum and angular momentum are derived. Lagrangian densities for the gravitational field are found by assuming that weak gravitational waves propagate at the speed of light. The assumption that gravitational energy is not itself a source of the gravitational field leads, as in a previous paper, to a theory that is at present observationally indistinguishable from Einstein's; the opposite assumption leads to a distinguishable theory. The interactions of the gravitational field with the electromagnetic field and with an ideal fluid are discussed. The simplicity of the theory (space–time formally flat and one scalar potential to describe the gravitational field) is emphasized. (auth)

48371 CYLINDRICALLY SYMMETRIC DISTRIBUTIONS OF MATTER AND MAGNETIC ENERGY IN EQUILIBRIUM IN GENERAL RELATIVITY. Banerji, S. (Univ. of Burdwan, India). J. Phys., A (London), 1: 520-6(Sept. 1968).

Solutions of the Einstein–Maxwell equations corresponding to cylindrically symmetric distributions of stressless conducting matter with an axial magnetic field were found, which can be matched with an outside pure magnetic field solution originally due to Bonnor (1954). It is also shown that Melvin's magnetic universe (Melvin, M. A., 1964, Phys. Lett. 8: 65) cannot be fitted with dust distributions in this way. (auth)

Scattering Theory

Refer also to abstracts 48327 and 48630.

48372 (JINR-E2-3948) DIFFERENCE HYPERGEOMETRIC EQUATIONS AND THE RELATIVISTIC COULOMB PROBLEM. Freeman, M.; Kadyshevskii, V. G.; Mir-Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 15p. Dep.

Finite-difference analogs of hypergeometric functions are introduced and the equations which they satisfy are found. The results obtained are used in finding the exact solution to the Coulomb problem, in the framework of the quasipotential approach. (auth)

48373 REGGE POLE AND K-MATRIX MODELS FOR TWO-PARTICLE REACTIONS. Hite, Gerald Eugene. Urbana, Ill., Univ. of Illinois, 1967. 158p.

Thesis.

A generalized expression for Reggeized helicity amplitudes is presented. It is found that the kinematic t-singularities of the amplitudes associated with a Regge trajectory for a given reaction are described by a single function whose origin can be easily understood in terms of angular momentum coupling rules. A discussion is given concerning the constraints imposed on the Regge residue functions from the demand that certain physical quantities, such as the cross section, be free of kinematical singularities. Particular consideration is given to the t-channel reaction $\bar{N}N \rightarrow PV$. Solutions for the residue functions are obtained for this reaction for all trajectories with natural parity and for all trajectories with unnatural parity whose G-parity restricts the $\bar{N}N$ channel spin to be zero. Using these solutions, cross sections and

decay correlations for the vector meson are calculated for a comparison to experiment. The K^+p reactions near 1 BeV/c are studied using the K-matrix formalism. It is found that the general features of the experimental data, including the I = 1 peak in the total cross section are reproduced without the assumption of a KN resonance. It is found the agreement with experiment is best for the KN^* channel which appears to be responsible for the peak in the total cross section. (Disser. Abstr.)

48374 PARTIAL-WAVE SPINOR AMPLITUDES WITH DEFINITE PARITY. Hwa, Rudolph C. (State Univ. of New York, Stony Brook). Contract AT(30-1)-3668B. Ann. Phys. (N. Y.), 49: 39-68(1968).

For the purpose of supplying an alternative to the use of helicity amplitudes as a means of describing scattering processes involving particles of any spin, partial-wave spinor amplitudes (or M functions) with definite parity are constructed. Consequences of time reversal invariance and identity of particles are investigated. Connection with the partial-wave helicity amplitudes is established. Applications of the spinor formalism to the pion–nucleon and nucleon–nucleon problems are studied in detail. The formalism provides a direct link between the elegant work of Stapp, Hepp, and Williams on the analytic properties of the M function and phenomenological analysis in terms of partial-wave amplitudes with definite parity without recourse to the helicity description. (auth)

48375 NEW APPROACH TO THE KINEMATICS OF RELATIVISTIC SCATTERING AND TO THE CONSTRAINTS AMONG PARTIAL WAVES. Rebbi, C. (California Inst. of Tech., Pasadena, Calif.). Contract AT(11-1)-68. Ann. Phys. (N. Y.), 49: 106-29(1968).

A new set of relativistic invariant amplitudes, recently introduced by de Alfaro, Fubini, Furlan, and Rossetti are studied and further developed for the description of a scattering of particles with spin. The main feature of these amplitudes is that their expansion into partial waves is always simply an expansion into a series of Legendre polynomials. It is also shown how some of the constraints among partial waves, which are known to hold for t = 0, immediately follow when the new amplitudes are used to describe the scattering. (auth)

48376 UNITARY REPRESENTATION OF MULTICHANNEL AMPLITUDES. Kowalski, K. L.; Krauss, J. (Case Western Reserve Univ., Cleveland). Nuovo Cim., 57B: 30-5(Sept. 11, 1968).

A representation for two-body multichannel amplitudes is found in terms of the solution of a nonsingular integral equation which permits the construction of systematic unitary approximations. (auth)

48377 CROSSING RELATIONS OF DOUBLE BREIT SYSTEM HELICITY AMPLITUDES. Bjoerneboe, Jens (Nordisk Institut for Teoretisk Atomfysik, Copenhagen); Koba, Ziro. Nucl. Phys., B7: 53-67(1968).

Crossing relations of helicity amplitudes are made essentially diagonal by referring them to the Breit system of uncrossed particles. A simplified analysis of the crossing procedure is presented in terms of the "double Breit system" helicity amplitudes. (auth)

48378 BOUND STATES IN S-MATRIX THEORY. Blomberg, Thomas. (Univ. of Stockholm). Ark. Fys., 37: 13-23 (1968).

Starting with pure S-matrix theory eigenvalue equations for the vertex functions which describe the properties of a bound state can be derived. The vertex functions which here are defined by means of the S-matrix have a close connection with the nonrelativistic wave function. In the case of electrodynamics (a hydrogen atom) the usual Schrödinger equation was derived as a certain approximation to the S-matrix-theoretical equations. (Swed)

48379 ON THE GROUP-THEORETICAL APPROACH TO THE CONSPIRACY PROBLEM FOR ARBITRARY MASSES. I. Cosenza, G. (Univ., Naples. Univ., Rome); Sciarrino, A.; Toller, M. Nuovo Cim., 57A: 253-300(Sept. 21, 1968).

The scattering amplitude for an arbitrary two-particle process is written as a function $T^{W}_{m_1 m_2 m_3 m_4}(h)$, where W is the square of the four-momentum transfer and h is an element of a subgroup H^{c}_{W} of the complex Lorentz group. If suitable conventions are used, this function is shown to be free of kinematic singularities and free of kinematic constraints, apart from two covariance conditions of group-theoretical nature. The usefulness of this function in the treatment of the kinematic conditions in a Regge-pole model is shown and discussed. The matrix elements of the representations of the homogeneous Lorentz group are used in order to obtain explicit expressions for this function, which satisfy, above a certain energy and for small momentum transfer, all the requirements of analyticity and covariance. These expressions are equivalent to the contribution of a family of parallel conspiring Regge trajectories with well-defined quantum numbers and factorized residues. In this first part, only unequal-mass scattering is treated in detail. A detailed treatment of the equal-mass case and of the general factorization conditions will be given in the second part of this paper. (auth)

48380 DERIVATION OF UPPER BOUNDS FOR FORWARD AND FIXED-MOMENTUM-TRANSFER SCATTERING AMPLITUDES AT HIGH ENERGIES. Chadan, K. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim., 57A: 436-9(Sept. 21, 1968).

A simple derivation is given of high-energy upper bounds for forward and nearly forward (fixed-momentum transfer) scattering amplitudes which satisfy the analyticity properties of axiomatic quantum field theory. (L.B.S.)

48381 APPROACH TO SCATTERING PROBLEMS THROUGH INTERPOLATION FORMULAS AND APPLICATION TO SPIN–ORBIT POTENTIALS. Sabatier, Pierre C. (Indiana Univ., Bloomington). J. Math. Phys. (N. Y.), 9: 1241-58(Aug. 1968).

In many problems of potential scattering, and particularly in the inverse-scattering problem, two equations prove to be of essential interest: the Gel'fand–Levitan equation and the Regge–Newton equation. These and their generalizations apply, respectively, to energy-independent and to λ-independent potentials. A method is devised for obtaining equations applying to more general cases. The requirement is the existence of analytic properties of the wavefunctions corresponding to special classes of potentials, enabling one to construct interpolation formulas of the Lagrange form. From these formulas, it is possible to derive integral equations which may then be generalizable to much larger classes of potentials. This method is fully developed in the case of potentials depending linearly on λ. Interpolation formulas and analytic properties of the wavefunctions in the λ plane are exhibited. Integral equations are given and proved to apply to very large classes of potentials. Existence, uniqueness, and analytic properties of their solutions are thoroughly studied. An example is given for which all the wavefunctions are calculated exactly. (auth)

48382 PROPERTIES OF THE S MATRIX FOR VELOCITY-DEPENDENT POTENTIALS. Ferreira, Erasmo M. (Univ. Central de Venezuela, Caracas. Instituto de Pesquisas da Marinham, Rio de Janeiro. Univ. Catolica, Rio de Janeiro); Guillen, Nilo; Sesma, Javier. J. Math. Phys. (N. Y.), 9: 1210-23(Aug. 1968).

Solutions of the Schrödinger equation with a velocity-dependent potential are discussed. The analytic behavior of the S matrix as a function of the momentum is investigated, and some properties of general validity are demonstrated. The configuration of the poles of the scattering matrix in the complex momentum plane is described in detail for the case of a spherically symmetric potential. (auth)

48383 TWO METHODS FOR RESOLVING THE NONRELATIVISTIC THREE-BODY PROBLEM. Komarov, V. V.; Obukhovskii, I. T.; Popova, A. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 3, 94-9(May-June 1968). (In Russian).

A method suggested by L. D. Faddeev (Zh. Exp. Teoret. Fiz. 39, 1959, 1960) and a diagram summation method were used for deriving a system of integral equations for relativistic three-particle scattering amplitude. It was found that the Faddeev investigation of integral equation kernels may be used for supporting the summation of infinite series of Feynman diagrams in non-relativistic problems of particle interactions. (tr-auth)

48384 ASYMPTOTIC BEHAVIOR OF INFINITELY RISING TRAJECTORIES. Childers, R. W. (Univ. of Tennessee, Knoxville). Phys. Rev. Lett., 21: 868-71(Sept. 16, 1968).

Infinitely rising trajectories are shown to be consistent with the usual features of dispersion theory and Regge-pole theory only if the trajectories behave, to within logarithmic factors, as $\sqrt{s}$ as $s \to +\infty$. For such trajectories the imaginary part must increase more rapidly than the real part. (auth)

48385 CALCULATION OF PROBABILITIES OF SCATTERING PROCESSES WITH POLARIZED SPIN-1/2 PARTICLES. Dogyust, I. V.; Stepanovskii, Yu. P. Yadern. Fiz., 8: 382-4(Aug. 1968). (In Russian).

A description of polarization states for spin-$\frac{1}{2}$ particles is discussed. Bilinear combinations of bispinors describing particles with definite four momenta, are considered. Formulas are given which allow one to express an arbitrary bispinor combination

through the vector, the pseudoscalar, and the scalar, or through the pseudovector, the pseudoscalar, and the scalar. Tables are presented where all the quadric forms of these combinations are expressed through momenta and polarizations of the particles. (auth)

Particle Accelerators

Refer also to abstracts 47375, 47384, 48037, and 48509.

48386 (CERN/ECFA–67/13(Rev.2)) ECFA: EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS REPORT, 1967. (European Organization for Nuclear Research, Geneva (Switzerland)). May 15, 1967. 125p. (CERN–700). Dep.

A study of the design and utilization of a 300-GeV proton synchrotron and a survey of the state of high-energy physics in CERN member states are presented. Conclusions and recommendations of the ECFA are summarized. (W.H.K.)

48387 (CERN/ECFA–67/16(Vol.1)) ECFA: EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS. UTILIZATION STUDIES FOR A 300 GeV PROTON SYNCHROTRON. (European Organization for Nuclear Research, Geneva (Switzerland)). May 30, 1967. 418p. Dep.

Papers presented on statistical thermodynamics of strong interactions at high energies, beam layout problems, and a 50 GeV experimental area for the 300 GeV machine. Papers on possible experiments include measuring stable particles produced at 300 GeV, total cross-section experiments, coherent interactions of complex nuclei as selective device in production of resonances at high energies, 300 GeV/c elastic scattering experiment, search for quarks with 300 GeV protons, and measurement of the real part of the forward scattering amplitude for π^+-p at momenta up 40 GeV/c. Detection problems and devices are considered including the detection of π^0 mesons, neutrons, and neutrinos. The operation and design parameters for bubble chambers and spark chambers are also discussed. (W.H.K.)

48388 (CERN/ECFA–67/16(Vol.2)) ECFA: EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS. UTILIZATION STUDIES FOR A 300 GeV PROTON SYNCHROTRON. (European Organization for Nuclear Research, Geneva (Switzerland)). May 30, 1967. 477p. (In English and French). Dep.

Papers are presented on possible beam designs including neutrino beams, hyperon beams, and an rf separator for K–π separation. Beam transport components are discussed including superconducting magnets and rf particle separators. Papers on target stations and shielding include Monte Carlo calculation of nucleon–meson cascade in a block of shielding material and muon shielding calculations. Other papers include feasibility of beam by-pass for the synchrotron, beam ejection at 50 to 100 GeV/c, access to the synchrotron, protection around an external target at 45 GeV, and beam transport systems at 50 GeV. (W.H.K.)

48389 (JINR–P9–3968) AMPLITUDE SPECTRA OF RADIAL AND AXIAL BETATRON OSCILLATIONS IN THE JINR SYNCHROCYCLOTRON. Danilov, V. I.; Enchevich, I. B.; Polferov, E. A.; Rozanov, E. I.; Safonov, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 25p. (In Russian). Dep.

Methods are described for determining the amplitude spectra of radial and axial betatron oscillations of the beam particles in the synchrocyclotron. After calculations, made for the 680-MeV synchrocyclotron, the value of the maximum amplitude of the betatron radial oscillations in the final radius was found to be 15 cm and the axial oscillations 2 cm. The spectrum of the vertical oscillations is close to the Gaussian distribution. In the spectrum of the radial oscillations, amplitudes below average prevail. (auth)

48390 (LA–3988) QUARTERLY STATUS REPORT ON THE MEDIUM-ENERGY PHYSICS PROGRAM FOR THE PERIOD ENDING JULY 31, 1968. (Los Alamos Scientific Lab., N. Mex.). Aug. 29, 1968. Contract W-7405-eng-36. 41p. Dep. CFSTI.

Recent developments at LAMPF are discussed including developments in accelerator structures, rf power systems, accelerator control and instrumentation, accelerator physics, and the experimental area. (W.H.K.)

48391 (NP–tr–1669) EMERGENCE OF A HYDROGEN JET FROM A SUPERSONIC NOZZLE INTO A VACUUM. Dimov, G. I. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Culham Lab., Abingdon, Eng., from a report. 14p. (CTO–502). Dep. CFSTI. UK.

For the injection of charge-exchange protons into an accelerator at the Institute of Nuclear Physics the charge-exchange target in the orbit of the accelerator is formed by a supersonic hydrogen jet operating for the duration of the injection pulse between 100 and 1000 μsec. The design and operation of the system for obtaining a supersonic hydrogen jet are described. (W.H.K.)

48392 (ORNL–tr–1989) NEUTRON TRANSMISSION IN THE ACCESS TUNNELS TO A HIGH-ENERGY PROTON ACCELERATOR. d'Hombres, Marguerite-Marie; Devillers, Christian; Gervaise, Francois; de Sereville, Bernard; Tardy-Joubert, Philippe (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated from report CEA–R–3491. 34p. Dep. CFSTI.

The tridimensional monoenergetic Monte-Carlo code "ZEUS" has been used in order to fit the results of measurements of absorbed dose made in the access tunnels of the CERN 28 GeV proton synchrotron. Reemission of neutrons by walls was represented by albedo of absorbed dose. The experimental results are corresponding to the results of calculations done for neutrons in the energy interval 0.75 to 4 MeV. (auth)

48393 (ORO–3346–29) USE OF THROW AWAY CARTRIDGES TO CONTAIN TRITIUM RELEASED IN NEUTRON GENERATORS. Zimmerman, Robert L.; Boyd, Robert M.; Wright, John R.; Mitchell, Martin W. (Georgia Inst. of Tech., Atlanta. Office of Radiological Safety). Apr. 1968. Contract AT(40-1)-1346. 6p. (CONF-680411–3). Dep. CFSTI.

From Conference on Small Accelerators, Oak Ridge, Tenn.

The use of a throw-away molecular sieve cartridge in the vacuum line between the ion pump and the roughing pump for concentrating the tritium which is freed for neutron generator targets is described. In addition to reducing tritium contamination resulting from the operation, this device improves the generator output by adsorbing contaminants which degrade the desired low vacuum characteristics. (W.H.K.)

48394 (UCRL–18218) VELOCITY SPECTROMETERS USED IN BEVATRON DEFLECTED BEAM RESEARCH. Edwards, George W. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 30, 1968. Contract W-7405-eng-48. 6p. (CONF-680916–1). Dep. CFSTI.

From 3rd International Symposium on Discharges and Electrical Insulation in Vacuum, Paris, France.

Four glass cathode parallel-plate velocity spectrometers which have been used in secondary beam particle research are described. Two of these units have 10-foot-long and two have 15-foot-long electrodes. All units have 12-inch-wide electrodes. These units operate at up to 625 kV for many months without appreciable maintenance. On occasion the same unit has been used in several experiments with a total in use time of 6 to 8 months. Initial voltage conditioning is at $\sim 5 \times 10^{-6}$ torr. Above about 350 kV the vacuum is reduced to about 1 micron by a controlled argon leak into the chamber. Total conditioning time is usually less than 24 hours. About every 3 months a high-vacuum ($\sim 5 \times 10^{-6}$ torr) low-voltage reconditioning of about 6 hours is required. Current consumption, including power supply, is approximately <150 μA on each electrode (<300 μA total). Glass temperatures are maintained at about 105°C, thereby reducing volume resistivity to between 4×10^8 and 1.5×10^{10} Ω cm. This evaluated temperature appears to retard the collection of hydrocarbons that can cause breakdown. (auth)

48395 CRITERIA OF LONGITUDINAL STABILITY OF CIRCULATING BEAMS. Lebedev, A. N. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 37: 1652-9(Sept. 1967). (In Russian).

The longitudinal stability of azimuthally uniform intense beams in accelerators and storage rings was investigated. General characteristics of various kinds of instabilities are established and general stability criteria are obtained. A single dimensionless dispersion equation containing the normalized equilibrium-energy distribution of the particles was derived to serve as a basis for this analysis. Stable regions are indicated in equilibrium-energy distribution diagrams. Instabilities arising in a chamber with ideally conducting walls, including negative mass instability, associated with the fact that above the critical energy the particles converge in phase under the action of repulsive forces; instabilities arising because of particle-cavity interaction; and two-stream instability having the same mechanism as in the case of instability of a beam passing through plasma are considered. The other type of instability is associated with finite conductivity of chamber walls and is therefore called resistance instability. Established criteria are illustrated by the diagram presenting stability regions calculated for the circulating beam in the FIAN synchrocyclotron. (auth)

48396 DEVELOPMENT OF RESEARCH ON THE REALIZATION OF CYBERNETIC ACCELERATORS. Mints, A. L. (Radiotechnical Inst., Moscow). Usp. Fiz. Nauk, 93: 611-15(1967). (In Russian).

The principle of the cybernetic accelerator is based on automatically correcting the magnetic field by using data on the position of the orbit of the accelerated particles in the vacuum chamber placed in the gap of the accelerator electromagnet. The main features of the 1000-GeV accelerator of this type which is now being studied theoretically at the Radio Engineering Institute of AN USSR and of a 1-GeV model of the same accelerator are described. Three design variants are considered including a two-step system with linear injector for protons of energy 200 MeV, and a large ring system in which the particle energy increases from 200 MeV to 1000 GeV; a similar system with maximum linear accelerator energy 1 GeV; and a three-step system, with a linear accelerator up to 200 MeV, an intermediate ring accelerator to 16 GeV, and a large ring system accelerating the particles to 1000 GeV. The maximum projected field is 16 kOe. The heart of the cybernetic acceleration system is the method for compensating for the distortion of the magnetic-field configuration. This is done with the aid of 264 beam-deviation pickups and 528 correcting devices with amplifiers, all feeding the data to a Dnepr digital computer. The main parameters of the 1-GeV model, which is used to test the correctness of the design of the large accelerator, are presented. (ATD)

48397 DYNAMICAL STABILIZATION OF THE NEGATIVE MASS EFFECT IN MODULATED BEAMS. Perel'shtein, E. A. Zh. Tekh. Fiz., 37: 1648-51(Sept. 1967). (In Russian).

The stability of a ring-shaped beam of monoenergetic charged particles whose density is sinusoidally modulated azimuthally is discussed. The calculations were undertaken to determine whether the longitudinal instability (negative mass effect) that appears in storage rings when the particle energy exceeds a critical value can be stabilized by density modulation. The calculations are based on the self-consistent field equations of C. E. Nielsen, A. M. Sessler, and K. R. Symon (Proceedings of the International Conference on High Energy Accelerators, Geneva, 239, 1959) and the equations for the first two moments of the particle distribution function. Conditions are found for the existence of a stationary state for the density modulated beam. These conditions can be realized by proper design of the chamber. The longitudinal stability of the steady state density modulated beam is discussed, and it is shown that the beam is stable if the square of the fractional modulation depth exceeds $4\pi G^2R^2/v^2$, where G is the growth rate of the negative mass instability in the corresponding unmodulated beam, R is the radius of the ring, and v is the velocity of the particles. The calculations are valid only for small modulation depths. It is shown that the maximum density of the beam for which the stability criterion is met with a small modulation depth increases with increasing particle energy. (auth)

48398 WINDING SYSTEM FOR MAGNET EXCITATION COILS OF PARTICLE ACCELERATORS. (to United States Atomic Energy Commission). British Patent 1,126,433. Sept. 5, 1968. Priority date July 13, 1965, United States.

An improved winding arrangement for the magnet excitation coils of particle accelerators with alternating-gradient focusing is described. (W.H.K.)

48399 ATOMIC BEAM APPARATUS. Holloway, Joseph H.; Anderson, Joseph W. (to Hewlett-Packard Co.). U. S. Patent 3,397,310. Aug. 13, 1968. Filed Oct. 29, 1962.

A cesium beam tube is described. A cesium ampule is ruptured after evacuation of the tube by means of an electrical discharge which vaporizes a thin walled portion of the ampule. (auth)

48400 COMPENSATION OF SPHERICAL ABERRATION OF QUADRUPOLE LENSES WITH THE AID OF OCTUPOLES. Fishkova, T. Ya.; Yavor, S. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 686-93(Apr. 1968). (In Russian).

Using the results of earlier calculations for quadrupole lenses, different combinations of quadrupole lenses are analyzed to ensure minimum spherical aberration. The aberration coefficient due to the octupoles is calculated for the case when the octupoles are combined with the quadrupoles and for the case when they are located separately. Analytic formulas are derived for short lenses and in the approximation in which it is assumed that the field distribution is rectangular. Expressions are obtained for the parameters of the quadrupole and octupole lenses, for which partial and complete compensation of third-order spherical aberration takes place. Plots are presented of the dependence of the excitations of the octupoles on the object position, required to correct a stigmatic doublet of short quadrupole–octupole lenses in the case of large magnification. The results of the calculations were confirmed by experiments on the compensation of spherical aberration in the central plane of electrostatic quadrupole lenses with the aid of both superimposed and separate octupoles. (ATD)

48401 COEFFICIENTS OF SPHERICAL ABERRATION OF A STIGMATIC DOUBLET OF QUADRUPOLE LENSES (RECTANGULAR MODEL). Fishkova, T. Ya.; Baranova, L. A.; Yavor, S. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 38: 694-703(Apr. 1968). (In Russian).

Analytic expressions for the coefficients of spherical aberration of a stigmatic doublet made up of quadrupole lenses under the assumption that the incident beam is astigmatic and the field distribution along the lens axis is rectangular are derived. The coefficients of spherical aberration of a doublet of such lenses were determined with a BESM-2M electronic computer for the case of a point image and a point source. The calculations were made for a wide range of parameters and for different field configurations. The results are presented in the form of plots. It is shown that the minimum spherical aberration is obtained if large magnification is used and the object is at the edge of the field. The results are compared with the coefficients of spherical aberration of a single quadrupole lens and of an axisymmetric magnetic lens. (ATD)

48402 ON QUASI-SHOCK WAVES IN ELECTRON BEAMS. Gladun, A. D. (Moscow Physical-Technical Inst.). Zh. Eksp. Teor. Fiz., 55: 499-505(Aug. 1968). (In Russian).

It is demonstrated that quasi-shock waves with an oscillatory structure can propagate in an electron beam moving on a fixed ion background or in a certain wave guide system. (auth)

48403 ON PONDEROMOTIVE EFFECTS OF ELECTROMAGNETIC RADIATION. Shapiro, V. E. (Inst. of Physics, Krasnoyarsk, USSR). Zh. Eksp. Teor. Fiz., 55: 577-83(Aug. 1968). (In Russian).

Some features of ponderomotive effects in electromagnetic wave resonance systems are investigated for the case when the frequency of the mechanical system is much smaller than that of the electromagnetic waves. The nature of the retardation effects is discussed and conditions for appearance of ponderomotive instabilities near resonance of degenerate and nondegenerate radiation systems are considered. The approach developed can be applied for analysis of electro- and magnetostrictive effects accompanied by dimensional as well as frequency resonances of the electromagnetic system. (auth)

48404 PROPAGATION OF PLANE ELECTROMAGNETIC WAVES IN A STATIONARY FIELD. Narozhnyi, N. B. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz., 55: 714-21 (Aug. 1968). (In Russian).

The polarization operator in a stationary crossed field and the radiative corrections to the photon Green function in the field are calculated. It is demonstrated that two waves with different dispersion laws may propagate in a stationary crossed field. The refractive indices are found and the problem regarding the direction of propagation and the polarization of the two waves is studied. (auth)

48405 SPACE CHARGE EFFECTS ON SYNCHROTRON FREQUENCY. Prelec, K.; Passner, A. (Princeton Univ., N. J.). Rev. Sci. Instrum., 39: 1577-8(Oct. 1968).

The influence of the space charge on synchrotron oscillations in a weak focusing synchrotron is discussed. A procedure for obtaining the expression for a relatively small synchrotron frequency shift in the low energy limit is briefly described. (W.H.K.)

48406 SPECIMEN HOLDER FOR IRRADIATION OF BIOLOGICAL SUSPENSIONS WITH FAST PROTONS. Rikmenspoel, Robert (State Univ. of New York, Albany); van Herpen, Gerard. Rev. Sci. Instrum., 39: 1583-4(Oct. 1968).

In the course of a series of experiments in which a suspension of bull spermatozoa was bombarded with 24-MeV protons, a specimen holder was designed which satisfies the following requirements: the cuvettes holding the suspensions are quickly interchangeable without interfering with the vacuum system of the cyclotron; the temperature of the specimen may be kept close to 4°C; and the beam intensity may be $<10^{-10}$A/cm^2 of exposed area. A brief description is presented. (W.H.K.)

48407 CHARGED PARTICLE EXTRACTING MAGNET FOR AN ACCELERATOR. (to United States Atomic Energy Commission). British Patent 1,127,865. Sept. 18, 1968. Priority date July 13, 1965, United States.

An extractor for deflection of a beam of charged particles from an orbital path in a charged particle accelerator is described. It comprises a long magnetic core with a longitudinal passageway, a septum wall of the passageway having a thinned longitudinal portion disposed adjacent the orbital path of the particles, a coil disposed longitudinally through the passageway and arranged to induce a magnetic field across the passageway perpendicular to the thinned longitudinal portion of the septum wall. (W.H.K.)

48408 LABORATORY FACILITY FOR IONOSPHERIC REACTION STUDIES. Hirsh, M. N.; Eisner, P. N.; Slevin, J. A. (Dewey Corp., New York). Rev. Sci. Instrum., 39: 1547-55(Oct. 1968).

Techniques employed in the laboratory investigation of charged and neutral particle reactions of importance in the ionosphere are described. Atmospheric gases at densities appropriate to the D region, contained in a large reaction chamber, are irradiated by a spatially uniform flux of 1.5 MeV electrons. The resulting reactions are studied by a combination of resonant cavity measurements of electron density, mass analysis of positive and negative ions, and optical emission spectroscopy, both during continuous beam irradiation of the gas and in the radiation afterglow. Mechanisms and rates for molecular production and loss processes have been investigated using this apparatus under conditions resembling those in the ionosphere, with negligible competition from diffusion losses to the container walls. In addition to descriptions of the techniques, the paper includes examples of measurements made with the experimental system. (auth)

48409 AUTOMATIC FOCUS CONTROL OF CHARGED-PARTICLE BEAMS. Dost, M. H. IBM J. Res. Develop., 12: 171-9(Mar. 1968).

The mechanism of focusing a beam of charged particles, in particular an electron beam, is reviewed. Analytic expressions are derived relating spot size in the image plane to variables and parameters. Two specific feedback control system design concepts are described, one of which is being used in the electron-beam recorder of an IBM photodigital mass storage system. Since the electron beam focus control system has been implemented and found to function well in the field, automatic focus control of charged particle beams is indeed feasible and practical. Comparison of experimental data with results obtained by digital simulation indicates that a valid mathematical model of the control system exists, allowing analytic studies of the present system as well as extensions in the future. (BBB)

48410 C.E.R.N. Gregory, Bernard (CERN, Paris). Sciences (Paris), No. 52, 36-49(Nov.-Dec. 1967). (In French).

Progress in particle physics and its importance to basic research is described. High-energy particles are considered as the frontier of physics. Equipment and installations of the CERN laboratories at Meyrin are described. The largest particle generator of CERN is 28-GeV proton synchrotron. At maximum energy it can attain a repetition of impulses every 5 sec (at 10 GeV, one per second). Each impulse groups 20 packets of protons which total 10^{12} particles. They are accelerated in 1.2 sec while rotating ~500,000 times around a 200-m dia ring and are channeled into a vacuum chamber by a series of electromagnets. Other machines and features of the CERN laboratory are explained. The importance of particle physics to the European atomic energy progress is stressed. A plan is discussed for a 300-GeV machine for European use. (BBB)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 47318, 47320, 48141, 48142, 48150, 48508, 48801, and 48802.

48411 (AERE-R-5778) THE HARWELL SCATTERING LAW PROGRAMME: FREQUENCY DISTRIBUTIONS OF MODERATORS. Page, D. I.; Haywood, B. C. (Atomic Energy Research Establishment, Harwell (England)). May 1968. 33p. Dep. CFSTI. UK 5s. 0d.

The frequency distributions of moderators at various temperatures measured by the Harwell–Chalk River Scattering Law Project are tabulated and shown graphically. References are given to the best available experimental data from which the distributions are derived. The methods used to estimate the correction factors for the data are indicated in each case. (auth)

48412 (AERE-Trans-1088) EXPERIMENTAL STUDY OF THE NEUTRON THERMALISATION PROCESS IN TIME IN HYDROGENOUS MODERATORS. Ishmaev, S. N.; Mostovoi, V. I.; Sadikov, I. P.; Chernyshov, A. A. Translated by J. W. Newmarch-Holmes for Atomic Energy Research Establishment, Harwell, Eng., from pp 643-55 of Pulsed Neutron Research, Vol. I, Symposium held at Karlsruhe, 10–14 May 1965, Vienna, International Atomic Energy Agency. 17p. Dep. CFSTI. UK 3s.

Using a method described in (Pulsed Neutron Research, 1: 623-41(1965) (AERE-Trans 1084)), the authors measured nonstationary neutron spectra in zirconium hydride and in water at room temperature as a function of slowing-down time, with a resolution of 3.5 μs. The spectra measured in a large ZrH prism ($B^2 = 3.8 \times 10^{-2}$ cm^{-2}) (B = geometric buckling) belong to a range of slowing-down times greater than 30 μs, in which the mean neutron energy is less than 0.13 eV and the energy exchange between the neutron gas and the medium is caused mainly by the excitation of acoustic lattice vibrations. In this range thermalization proceeds comparatively slowly, and the time required to establish an equilibrium neutron spectrum is of the order of 400 μs. In a small ZrH assembly ($B^2 \simeq 20 \times 10^{-2}$ cm^{-2}), a strong diffusion-cooling effect is observed. The spectra measured with long slowing-down times were found to differ considerably from the Maxwellian distribution according to the temperature of the medium. The time required to establish an equilibrium energy distribution increased with decreasing system size. Neutron energy spectra in water ($B^2 = 2.56 \times 10^{-2}$ cm^{-2}) are presented for slowing-down times of over 13 μs, where distortion due to resolution is negligible. The shape of the spectrum is fully consistent with the Maxwellian distribution at room temperature only after approximately 100 μs following a fast neutron burst. The time required to establish an equilibrium neutron spectrum in this case was three to four times longer than the values calculated by various other authors. Possible reasons for this discrepancy are discussed. (auth)

48413 (BNWL-855) MODIFICATION OF SAND II. Berg, S. (TRW Systems Group, Redondo Beach Calif.). Aug. 1968. Contract AT(45-1)-1830. 98p. Dep. CFSTI.

For Battelle-Northwest, Richland, Wash.

A modified version of the SAND II code for determining neutron flux spectra from multiple foil activation measurements is described. The program was altered primarily to retard the generation of spurious structure in neutron differential spectra, while allowing real structure to be indicated. (D.C.W.)

48414 (GA-8773) INTEGRAL NEUTRON THERMALIZATION. Quarterly Progress Report for the Period Ending June 30, 1968. Beyster, J. R.; Borgonovi, G. M.; Houston, D. H.; Koppel, J. U.; Slaggie, E. L.; Sprevak, D.; Young, J. A. (Gulf General Atomic, Inc., San Diego, Calif.). July 10, 1968. Contract AT-(04-3)-167. 50p. Dep. CFSTI.

A number of theoretical studies completed during this period are discussed. The final conclusions resulting from the first principles calculation for beryllium are summarized. A theoretical scattering law for UO_2 was completed; however, some additional numerical studies remain to be done before this work can be incorporated in the ENDF. A new model for polyethylene is also described, and comparisons between results of this model and experiment are presented. The lattice dynamical model for beryllium oxide was used to calculate a frequency spectrum and a scattering law in the incoherent approximation. A calculated total cross section for BeO, including coherent elastic scattering, is presented as part of this work. Some recently completed work on multiple scattering in double differential experiments is also described. This work relates to problems involved in the use of specially constructed samples designed to reduce multiple scattering. Reports on work in progress include an outline of efforts being made to improve capabilities for computing coherent inelastic scattering. Also some preliminary work is reported concerning efforts to broaden significantly the scope of the theoretical analyses underlying ENDF scattering laws by relating the temperature dependence of the frequency spectra to anharmonic effects. A report of the UC_2 total cross section experiment and the analysis of the data constitutes the section on experimental studies. (auth)

48415 (JAERI-1160) EFFECTIVE RESONANCE INTEGRAL OF THORIUM OXIDE IN HOMOGENEOUS MIXTURE. Obu, Makoto (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Dec. 1967. 5p. Dep.

The effective ^{232}Th resonance capture integrals were measured for homogeneous mixtures containing thorium oxide, using the activation technique. Experiments were performed in the blanket region with a thorium oxide-heavy water slurry, using the Aqueous Homogeneous Critical Facility (AHCF). In the blanket, the slurry was circulated with a circulation pump so that the concentration distribution was uniform. A correction was made by calculations for the deviation of the epithermal neutron flux from the 1/E distribution. The resonance integrals of the homogeneous dilution were found for the scattering cross section per absorbing atom in the range 160 ~ 4400 (10^{-24} cm^2). (NSA of Japan)

48416 (KFK-120(Pt.1)) NEUTRON CROSS SECTIONS FOR FAST REACTOR MATERIALS. PART I. EVALUATION. Schmidt, J. J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb. 1966. 1400p. (EANDC(E)-35-U(Pt.1)).

A comprehensive documentation and critical review of the available experimental and theoretical information on microscopic neutron cross section data are presented, and the procedures that were used to reduce this information into cross section sets in graphical and tabular form are described. The neutron energies considered range from 0.01 eV to 10 MeV, with emphasis on fast and resonance neutrons. The materials covered include C, Cr, He, H, Fe, Mo, Ni, O, ^{239}Pu, Na, ^{235}U, and ^{238}U. (D.C.W.)

48417 (N-68-25058) AGES OF D(D,N)^{3}He AND T(D,N)^{4}He NEUTRONS IN WATER AND TUNGSTEN-WATER MIXTURES. Alexander, Roger L.; Shook, Donald F.; Bogart, Donald (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1968. 22p. (NASA-TN-D-4581). CFSTI.

Ages for D–D and D–T neutrons were measured. Experimental and calculated ages were in agreement for water, but measured ages exceeded calculated ages for tungsten–water mixtures. The discrepancy increases with an increase in the volume fraction of metallic tungsten in the tungsten–water mixture. The most probable reasons for the discrepancy are incomplete data for the partial inelastic cross sections of the tungsten isotopes and the inadequacy of the evaporation model used to represent inelastic scattering above 1.5 MeV in the GAM II cross section compilation. (auth) (STAR)

48418 (NAA-SR-11980(Vol.2)) STORAGE OF MICROSCOPIC CROSS-SECTION DATA IN THE AIENDF. Berland, R. F.; Blaine, R. A. (Atomics International, Canoga Park, Calif.). July 31, 1968. Contract AT(04-3)-701. 116p. Dep. CFSTI.

The data storage and retrieval techniques for microscopic cross-section data are described. Instructions are given for using MOMUS and TOAD programs, which are written in FORTRAN H for the IBM 360 computer. The MOMUS Program is used to construct and maintain the microscopic neutron cross-section library, and the TOAD Program is used to construct and maintain the differential neutron angular distribution data library. (auth)

48419 (RCN-95) SATAN-2: A PROGRAM FOR THE CALCULATION OF THERMAL GROUP CONSTANTS BY MEANS OF CONVERTING THE ENERGY AND SPACE DEPENDENT INTEGRAL TRANSPORT EQUATION INTO AN ENERGY DEPENDENT ONE. Tas, A.; den Houting, A. W. (Reactor Centrum Nederland, Petten). June 1968. 131p. Dep.

The SATAN-2 program for the calculation of thermal group constants by conversion of the energy- and space-dependent integral transport equation into an energy-dependent equation is described. The program is written in ALGOL 60 for the EL-X8 computer. The mathematical formulation of the program is presented; and flow charts, sample input, and a listing of the program are included. (J.W.R.)

48420 (RFP-Trans-51) ANGULAR DISTRIBUTION SPECTRA OF GAMMA RADIATION FROM BEHIND A GRAPHITE BARRIER WITH A SOURCE WITH A PRIMARY ENERGY OF 4.45 MeV. Zolotukin, V. G.; Efimenko, B. A.; Matucevich, E. C.; Omarov, C. C. Translated by Dennis G. Vasilik (Rocky Flats Div., Dow Chemical Co., Golden, Colo.), from At. Energ. (USSR), 24: No. 1, 75-6(1968). 6p. Dep. CFSTI.

The angular distribution of gamma radiation emitted from a graphite block enclosing a Po–Be source was measured by means of the isotropic flux scintillation detection of gamma radiation caused by neutron inelastic scattering. (J.W.R.)

48421 (RHEL/M-135) A USER GUIDE TO THE ENDIM PROGRAMME. Stevenson, G. R. (Rutherford High Energy Lab., Chilton (England)). Nov. 1967. 12p. Dep.

The computer program ENDIM, which was written to unfold neutron energy spectra from the outputs of a number of detectors with energy-dependent response, is described. The program is written in FORTRAN IV for the IBM 360-75. A listing of the program is included. (J.W.R.)

48422 (RPI-328-133) LINEAR ACCELERATOR PROJECT. Progress Report, April 1, 1968–June 30, 1968. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 100p. Dep. CFSTI.

Separate abstracts were prepared for the four sections of the report. (D.C.W.)

For abstracts of individual sections see: 48423–48426.

48423 (RPI-328-133, pp 1-34) NEUTRON CROSS SECTIONS. (Rensselaer Polytechnic Inst., Troy, N. Y.).

The energy variation of $\bar{\nu}$ for ^{239}Pu was measured in 4 overlapping energy ranges from 0.01 eV to 10 keV; spin assignments for resonances of 22 to 100 eV were made. The absorption and fission cross sections of ^{239}Pu were measured from 0.01 eV to 30 keV; a preliminary evaluation of the neutron capture-to-fission ratio was made for the energy range from 1 to 30 keV. Simultaneous capture and transmission measurements were made for separated Hf isotopes. Gamma pulse-height spectra from experiments with the 1.25-m liquid scintillation capture detector are presented for ^{197}Au and ^{186}W. The angular distributions of neutrons scattered from resonances in Al were measured in order to determine the feasibility of this approach to assigning spins to $l > 0$ resonances. The technique of using the large liquid scintillation detector as an anticoincidence mantle was extended to fissile elements; preliminary scattering data for ^{239}Pu are presented. (D.C.W.)

48424 (RPI-328-133, pp 35-55) FAST REACTOR PHYSICS: EXPERIMENTAL. (Rensselaer Polytechnic Inst., Troy, N. Y.).

A series of position-dependent fast neutron spectrum measurements in rectangular assemblies of Fe and depleted U was performed; comparisons were made with theoretical predictions. Preliminary studies of an ^{6}Li glass detector for measuring intermediate neutron energy spectra were initiated. Some developments in detectors and associated electronic equipment for measuring fast neutron spectra are also summarized. (D.C.W.)

48425 (RPI-328-133, pp 56-9) LOW-ENERGY NEUTRON INELASTIC SCATTERING (LENIS). (Rensselaer Polytechnic Inst., Troy, N. Y.).

Data were obtained on neutron inelastic scattering by water at the following temperatures and neutron energies: 27°C and 0.040, 0.154, 0.332 eV; 170°C and 0.040, 0.154 eV; 270°C and 0.632 eV. Cross sections were calculated using a model based on the Haywood–Page frequency distribution without the Koppel modification. More data on the scattering law of UC was obtained at an incident neutron energy of 0.09 eV; the scattering law was calculated using a non-central Born Von-Karman approximation with five force constants. The input program MSCIN, which numerically generates the functions used in sampling from $S(\alpha,\beta)$, was generalized to an arbitrary α and β mesh. (D.C.W.)

48426 (RPI-328-133, pp 60-100) REACTOR PHYSICS: THEORETICAL. (Rensselaer Polytechnic Inst., Troy, N. Y.).

Progress in development of methods for calculating the space, energy, and time variations of the flux in a reactor is summarized. The ^{238}U temperature coefficient was calculated using Doppler-broadened p-wave neutron cross sections, and time-dependent thermal neutron spectra and time moments for H_2O were evaluated. The time moments of neutrons slowing down in heavy elements were also investigated, as was the average scattering angle in energy-dependent problems. Re-entrant hole effects on fast spectrum experiments in slab geometry were analyzed, treating Fe and depleted U slabs as examples. Analytical models for interpreting fast neutron time-of-flight spectrum measurements were studied. (D.C.W.)

48427 NEUTRON FLUX DISTRIBUTION AROUND THE DISK-SHAPED SOURCE OF ACCELERATOR TYPE NEUTRON GENERATORS. de Beeck, J. Op (Ghent Univ.). J. Radioanal. Chem., 1: 313-23(July 1968).

The neutron flux distribution around the disk-shaped sources of accelerator type fast neutron generators was calculated theoretically and was compared with experimental data. It was shown that the observed sharp flux gradients are inherent in the system and not due to non-ideal behavior of the experimental parameters. (auth)

48428 EMPIRICAL STUDY OF THE CONVERGENCE OF THE EIGENFUNCTION EXPANSION METHOD FOR INVESTIGATING NEUTRON WAVE PROPAGATION. Booth, R. S.; Swansiger, W. A. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Nucl. Sci. Eng., 33: 352-4(1968).

The convergence of the energy expansion used in the eigenfunction analysis of neutron wave propagation is investigated by an empirical approach. (J.W.R.)

48429 SCATTERING OF SLOW NEUTRONS FROM MOLECULES OF THE POINT GROUP C_{3v}. Buzano, C.; Rasetti, M. (Istituto di Fisica del Politecnico, Turin). Nuovo Cim., 57B: 1-18(Sept. 11, 1968).

An explicit formula for partial differential cross sections is derived, describing the scattering of slow neutrons from molecules of the point group C_{3v}. The possibility that the molecule may be found in a vibrational state different from the ground state, both before and after the scattering, is taken into account just in the way proposed in a previous paper by the authors. The use of the creation and annihilation operators is found quite powerful in handling the matrix elements. The average over orientations of vibrational modes is discussed, and selection rules are obtained for the transitions of the molecule. (auth)

48430 ENERGY SPECTRA OF NEUTRONS EMITTED BY A RaD–Be SOURCE. De Marco, Angelo; Garfagnini, Raffaello; Piragino, Guido. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 43: 509-13(Dec. 1967). (In Italian).

The energy spectrum of neutrons emitted by a Lead-210–Beryllium source was determined with a helium-filled diffusion cloud chamber. The symmetry of the apparatus was tested by measuring the apparent polarization of neutrons from the source. (auth)

48431 MEASUREMENT OF THE COHERENT NEUTRON SCATTERING AMPLITUDE OF DEUTERIUM, MERCURY, AND FLUORINE BY MIRROR REFLECTION. Bartolini, W.; Donaldson, R. E.; Groves, D. J. (Univ. of California, Livermore). Phys. Rev., 313-16(Oct. 5, 1968).

The bound coherent neutron scattering amplitudes of deuterium, mercury, and fluorine were measured by the mirror-reflection method. The measured values are $a_D = +6.21 \pm 0.04$ F, $a_{Hg} = +12.67 \pm 0.13$ F, and $a_F = +5.83 \pm 0.17$ F. The mercury and fluorine values are in agreement with presently accepted values. The deuterium value departs seriously from most previously reported measurements. This value implies $+6.13 \pm 0.04$ F for the quartet scattering amplitude, $+0.13 \pm 0.05$ F for the doublet scattering amplitude, and 3.15 ± 0.04 b for the free-atom scattering cross section of deuterium. (auth)

48432 CALCULATION OF THE TIME-DEPENDENT NEUTRON FLUX WITH THE MONTE CARLO METHOD. Kschwendt, H.; Rief, H. (EURATOM, Ispra, Italy). Z. Angew. Math. Mech., 47: T60-1(1967). (In German).

A method is outlined in which the individual neutrons are weighted. At each collision point, a neutron weight corresponding to the flux probability decreases by a calculable amount. This method is especially suitable for time-dependent flux calculations in small arrangements. Quantitative results showed that the method has less statistical error than the usual Monte Carlo method. (M.C.G.)

48433 DIVISION OF THE NEUTRON SPECTRUM INTO GROUPS. Grozd, G. G. (Inst. of Genetics and Cytology, Minsk). Radiobiologiya, 8: 145-8(1968). (In Russian).

The quite different energy ranges used to divide the neutron spectrum into groups are reviewed and a division is proposed for the spectrum of neutrons that act on biological tissue. Taken into consideration were two main processes: interactions of neutrons with the nuclei of atoms of the tissue and interactions of secondary particles formed during the action of neutrons on the tissue with elements of the tissue. The proposed energy ranges were 0 to 1.0 eV for thermal, 1.0 eV to 5 keV for slow (epithermal), 5 keV to 1 MeV for intermediate, 1 to 50 MeV for fast, and above 50 MeV for ultrafast neutrons. (JPRS)

48434 DIFFRACTION OF NEUTRONS ON A VIBRATING QUARTZ CRYSTAL. Chalupa, B. (Nuclear Research Inst., Rez,

Czechoslovakia); Michalec, R.; Petrzilka, V.; Tichy, J.; Zelenka, J. Phys. Status Solidi, 29: K51-4(Sept. 1, 1968).

The diffraction of a monochromatic beam of thermal neutrons on the (11.0) plane of a nonvibrating and a vibrating quartz crystal was studied. The resonance of the crystal was used in the vibration, and the frequency was 1 or 0.5 MHz. A 40-fold increase of the diffracted intensity was observed, but the halfwidth of the rocking curve remained unchanged. The ratio of intensities from vibrating and stationary crystals is plotted vs the hf current. (D.L.C.)

48435 SMALL-ANGLE SCATTERING OF SUBTHERMAL NEUTRONS FROM DEFORMED POLYCRYSTALLINE COPPER. Taglauer, E. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi, 29: 259-68(Sept. 1, 1968).

The small angle scattering of subthermal neutrons provides a method of investigating dislocations in cold-worked crystals. The scattering from polycrystals has several components, and these were investigated systematically in the case of copper. 1. One component can be ascribed to density fluctuations caused by distortion fields of statistically arranged edge dislocations. The dislocation density is approximately proportional to the flow stress and decreases with increasing grain size. 2. The double Bragg scattering observed at appropriate wavelengths agrees with theoretical predictions of Ogier et al. and can be explained by the fact that on deformation the grains are divided into subgrains. 3. At very small angles there is strong scattering that depends on the grain size. A few possible causes are discussed. (auth)

48436 EFFECTS OF MOLECULAR REORIENTATION IN SOLID METHANE ON THE QUASIELASTIC SCATTERING OF THERMAL NEUTRONS. Skoeld, Kurt (Argonne National Lab., Ill.). J. Chem. Phys., 49: 2443-5(Sept. 1, 1968).

Recent neutron-scattering measurements on solid methane show that the elastic peak is broadened in the high-temperature phase ($T > 20.4°K$) and that the broadening depends on the momentum transfer in a complicated manner. It is suggested that the broadening is due to frequent stepwise reorientation of the molecules. The widths predicted by this model are in qualitative agreement with the experimental results. The average time between successive rotational jumps is estimated to be about 10^{-12} sec at $T = 22.1°K$. (auth)

48437 NEUTRON SCATTERING FROM LIQUID HELIUM AT HIGH ENERGIES. Cowley, R. A.; Woods, A. D. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Lett., 21: 787-9(Sept. 16, 1968).

Neutron scattering from liquid helium at large energy and momentum transfers was found to be qualitatively consistent with an independent particle model. No evidence for a sharp peak related to the occupation of the zero momentum state was observed; but, from the temperature dependence of the width, a value of 17 ± 10% for the population of this state was deduced. Possible evidence for vortex creation accompanying the scattering process was obtained. (auth)

48438 EFFECTIVE SOURCE STRENGTH FOR ARBITRARILY ANISOTROPIC NEUTRON SCATTERING IN INFINITE MEDIUM. Inoenue, E.; Usseli, A. I. (Middle East Technical Univ., Ankara). Nucl. Sci. Eng., 34: 39-44(Oct. 1968).

Monoenergetic neutron transport without multiplication was considered in an infinite homogeneous medium with an arbitrarily anisotropic scattering law. Defining the effective source strength as the parameter β which appears in the asymptotic total flux $\psi_{As}(x) = (\gamma_0/2a)\beta \exp(-\gamma_0|x|)$ due to an isotropic plane source of unit strength localized at $x = 0$, γ_0 being the inverse diffusion length and a the ratio of absorption to total macroscopic cross sections, it is shown that in the series expansion of β in powers of the absorption parameter a, $\beta = \sum_{m=0}^{\infty} \beta_m a^m$, the coefficients β_m depend only on the first m + 1 Legendre moments of the scattering probability. (auth)

48439 MS_n, A NEW APPROACH TO NEUTRON TRANSPORT ANALYSIS. Nakamura, Shoichiro (Hitachi Ltd., Japan). Nucl. Sci. Eng., 34: 83-6(Oct. 1968).

Two new approximations for slab geometry, the MS_n and the Double-MS_n methods satisfying symmetry properties of solutions to the Boltzmann equation, are introduced. The validity of these methods is compared to other methods by evaluating the asymptotic decay constant, the Milne problem, and disadvantage factors. (J.W.R.)

48440 NEUTRON-WAVE PROPAGATION THROUGH A CRYSTALLINE MODERATOR. II. GRAPHITE. Ahmed, Feroz; Grover, P. S.; Kothari, L. S. (Univ. of Delhi). Nucl. Sci. Eng., 34: 33-8(Oct. 1968).

Neutron-wave propagation in the crystalline moderator, graphite, was studied by numerically solving the Boltzmann equation in the diffusion approximation. For each source frequency, the method employed (described in detail in Part I of this series) gives the fundamental mode eigenvalue and the corresponding neutron energy distribution. Various source frequencies in the range 10 to 500 cps were considered and it is shown that a discrete mode exists for $f < f^* \approx 350$ cps. The P^n coefficients and also the diffusion constant and diffusion cooling constant were obtained and compared with experimental data. The agreement between theoretical values of different parameters and the corresponding experimental data is better than what has so far been reported. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstract 48202.

48441 (AERE-M-2058) LIST OF RADIOACTIVE ISOTOPES IN ASCENDING ORDER OF HALF-LIFE. Bullock, R. J.; Large, N. R. (Atomic Energy Research Establishment, Harwell (England)). June 1968. 45p. Dep. CFSTI. UK 7s. 0d.

The radioactive isotopes listed in "Table of Isotopes", 6th Edition, (John Wiley & Sons, N. Y., 1967) have been arranged in order of ascending half-life by a computer program, to assist in the identification of isotopes of which only the half-life is known. (auth) (UK)

48442 (KFK-608) EXPERIMENTAL INVESTIGATIONS OF THE REACTIONS H(d,2p)n AND D(d,dp)n WITH 50 MeV DEUTERONS. Brueckmann, H.; Kluge, W.; Schaenzler, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). July 1967. 20p. (CONF-670629-9). Dep.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia.

A collimated beam of 51.5 MeV deuterons from the Karlsruhe isochronous cyclotron was used to investigate the three particle reactions p + d → n + p + p and d + d → d + p + n. The two emitted protons or the proton and the deuteron, respectively, were detected in coincidence with two scintillation counters. The experimental data for the reaction p(d,pp)n exhibit a pronounced peak due to final-state interaction between the outgoing neutron and one proton (the proton angles were chosen to be $\Theta_{lab} = 40°$ and $\Theta_{lab} = 25°$ accordingly). The analysis shows that this final-state interaction is dominated by the virtual singlet state of the deuteron. The extracted n-p scattering length is $|a_s| = 19 \pm 2.5$ f. In the investigation of the reaction d(d,dp)n the angles were chosen so as to observe predominantly the process where the neutron in the target deuteron acts as a "spectator" particle. The analysis in terms of the Chew-Low extrapolation procedure yields a straight line intersecting the E_n-axis at -0.95 ± 0.15 MeV (E_n, energy of the spectator neutron). The extrapolated d-p cross section is 14 ± 5 mb/sr. The value obtained from an independent measurement of elastic deuteron-proton scattering is 32 ± 3 mb/sr. (auth)

48443 ON THE REACTION ^{4}He(γ,pn)D. Erdas, F.; Quarati, P. (Univ., Cagliari, Italy. Univ. of Glasgow). Nuovo Cim., 57B: 243-6(Sept. 11, 1968).

Photodisintegration of ^{4}He is analyzed for multipolarity of the process (γ,pn). (J.W.R.)

48444 CALCULATION OF THE PHOTODISINTEGRATION CROSS SECTION OF ^{4}He. Beck, F.; Mueller-Arnke, A. (Technische Hochschule, Ger.). Phys. Lett., 27B: 343-4(Aug. 19, 1968).

The (γ,p) cross section for ^{4}He was calculated treating the particle-hole states of a system that consists of three different particles (a hole, a particle, and the core) interacting by mutual two-body interactions. It is concluded that the role of the particle-hole potential is essential in the photodisintegration of ^{4}He. (D.C.W.)

48445 BREAKUP OF DEUTERONS WITH 14.1-MeV NEUTRONS. Bruellmann, M.; Jung, H.; Meier, D.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Phys., A117: 419-48(1968). (In German).

Using a fast time-of-flight spectrometer, the neutron spectra $d^2\sigma/d\Omega dE$ of the reaction ^{2}H(n,2n)H were measured at an incident energy of 14.1 MeV. The investigation was carried out for eight angles lying between 7.5 and 75°, in the energy range of 2 MeV and the upper limit of the continuous distribution. At small angles, the peaks appearing in the central part and at the upper limit of the spectrum can be explained by means of the final-state interaction between the break-up nucleons. The structure of the spec-

trum decreases at larger angles, the peaks disappearing almost completely for $\theta_{lab} > 30°$. The differential break-up cross section $d\sigma/d\Omega$ is obtained by integration of the break-up spectra over the given energy range. For the emission of neutrons in the forward hemisphere, the total cross section was found to be $\sigma_V = 255 \pm 30$ mb. The results were compared with various theoretical and experimental values. (auth)

48446 NEUTRON CROSS SECTIONS OF DEUTERIUM IN THE ENERGY RANGE 0.0001 eV TO 20 MeV. Horsley, A. (Univ. of Birmingham, Eng.). Nucl. Data, Sect. A, 4: 321-57 (July 1968).

Experimental and theoretical data for the neutron cross sections of D are surveyed, and values are adopted for total and partial cross sections. To facilitate neutronics calculations, angular distribution functions based on n + d and the conjugate reaction p + d are given. The experimental data used, with some comments, and a brief account of the evaluation procedure are presented. (auth)

48447 PHOTODISINTEGRATION OF THE DEUTERON BETWEEN 100 AND 320 MeV. Smith, A. M.; Hall, S. J.; Mann, B.; Stewart, D. T. (Univ. of Glasgow). J. Phys., A (London), 1: 553-7(Sept. 1968).

The photodisintegration of the deuteron was studied for photon laboratory energies from 100 to 320 MeV. Recoil protons were detected in a counter telescope and the effects of more complex reactions investigated by varying the bremsstrahlung end-point energy. (auth) (UK)

48448 BINDING ENERGIES AND THE BACH. Lewis, D. T. (Lab. of Government Chemist, London). Chem. Ind. (London), No. 34, 1146-8(Aug. 24, 1968).

An extension is presented to the author's generic theory for the structure of subnuclear particles; this theory suggests that all such particles are composite assemblies of three neutral mass-energy entities, referred to as the Zeus (Z_0 = 0.1877 MeV), the tamaid (t = 25.9497 MeV), and the bach (b = 0.3233 MeV) (Nature, 216: 573 and 784 (1967) and Chem. Ind.: 23: 729 (1968)). The theory is discussed in relation to the hydrogen isotopes, the formation of Li, formation of the tritium nucleus, the uranium nucleus, etc. The binding energies of some of the lighter isotopes are tabulated in accordance with the theory. The mass-energy ratios are practically integral in all cases. Beyond $_2He^3$ tamaids become involved. Multiples of the "magic number" 11 feature prominently in the computations of binding energy, suggesting that the mass-energy term 11b is a dominant parameter in nucleic condensation. (UK)

48449 EFFECT OF VELOCITY-DEPENDENT NUCLEAR FORCES ON (γ,p) DISINTEGRATION OF THE ALPHA PARTICLE. Jain, S. C. (Allahabad Univ., India); Srivastava, B. K. J. Phys., A (London), 1: 558-63(Sept. 1968).

The total cross section $\sigma(\gamma,p)$ for the two-particle photo-disintegration of the alpha particle was calculated. The ground states of the alpha particle and the triton were described by modified Irving wave functions, the parameters of which had been determined from variational calculations of the binding energies of these systems, using a central velocity-dependent potential. The final-state interaction was neglected. The results were compared with the experiments of Gorbunov (1967) and with other similar calculations of Gunn and Irving (1951) and Bransden et al (1957). It was found that, though the velocity-dependent forces caused the total cross section $\sigma(\gamma,p)$ to change in the right direction, the discrepancy of fitting simultaneously the binding energy, rms radius, and the maximum cross section at the correct energy was not removed altogether. (auth) (UK)

48450 BINDING ENERGY AND THE WAVE FUNCTION OF ^3H AND ^3He ABSENCE OF A TRINEUTRON AND OF AN EXCITED STATE OF ^3H. Badalyan, A. M.; Gal'pern, E. S.; Lyakhovitskii, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 313-20(Aug. 1968). (In Russian).

Binding energies of ^3H and ^3He are found for the pair potentials of the well, exponential, and Yukawa-type by the method of K harmonics. The binding energy is found to be sensitive to the shape of the potential, and agreement with experiment is obtained only for the well potential (ϵ = 8.42 MeV for tritium). For this case the partial waves $\chi_0^0(\rho)$, $\chi_2^2(\rho)$, and $\chi_2^0(\rho)$ were also calculated for ^3H and ^3He; the difference in their values for ^3H and ^3He appeared to be negligibly small. It is shown that an excited level in tritium and a trineutron (with S = ½, L = 1) do not appear for real potentials and even for much deeper potentials. (auth)

48451 INVESTIGATION OF THE REACTION D(d,p)^3H WITH POLARIZED DEUTERON BEAM. Ad'yasevich, B. P.; Antonenko, V. G.; Kuznetsov, D. A.; Polunin, Yu. P.; Fomenko, D. E. Yadern. Fiz., 8: 267-73(Aug. 1968). (In Russian).

The effects of the tensor polarization in the deuteron energy region 160 to 470 keV were investigated in the reaction D(d,p)^3H with polarized deuterons. Angular dependences of analyzing powers of $P_{33}^{33}(\vartheta)$ $P_{11}^{11}(\vartheta) - P_{22}^{22}(\vartheta)$, and $P_{13}^{13}(\vartheta)$ were measured. Analysis of the results shows that the reaction has a considerable contribution from quintet states and that the contribution l = 3 in the output channels is to be taken into account. The conclusion on the presence of triplet-singlet transitions made in previous papers is not unambiguous. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 48156, 48207, 48286, 48441, 48448, 48604, 48607, 48609, and 48628.

48452 (JINR-P15-3965) INVESTIGATION OF THE ^9Be + T REACTION. Kim Syn Nam; Osetinskii, G. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1968. 28p. (In Russian). Dep.

The differential cross sections of the $^9Be(t,\alpha_0)^8Li$, $^9Be(t,\alpha_1)^8Li^*$, $^9Be(t,d_0)^{10}B$ reactions were measured using a thin Be target at 90 and 70° in the energy range 520 to 1700 keV. The angular distributions of both the groups of α particles were measured for a number of triton energies. The results show that in the range of the compound nucleus ^{12}B excitation energy from 13.3 to 14.2 keV, sufficiently narrow energy levels are not observed. On the basis of the angular distributions the total cross sections of the yield of the mentioned α-particle groups of the reaction are obtained. (auth)

48453 ANGULAR DISTRIBUTION OF THE NEUTRONS FROM $^7Li(d,n)^8Be$ REACTIONS AND THE ENERGY LEVELS IN ^8Be. Saxena, M. K.; Sah, J. P. (Lucknow Univ., India). Curr. Sci. (India), 37: 391-4(July 20, 1968).

The energy levels of ^8Be were investigated using the reaction $^7Li(d,n)^8Be$. A target of ordinary Li was bombarded with 500-keV deuterons; and Ilford G5 plates were exposed to the emitted neutrons at angles of 0, 45, 60, 90, 120, 135, and 150°. Angular distributions and energy spectra of the neutrons were obtained. Evidence was noted for levels in ^8Be at excitations of 2.1, 2.8, 3.5, 4.1, 4.88, 5.96, 6.55, and 7.57 MeV. The angular distribution of the neutrons shows that the formation of ^8Be in the ground state is predominantly due to the stripping process. Analysis of the data indicates that the ground state of ^8Be is either 0^+ or 2^+. (D.C.W.)

48454 R-MATRIX FIT TO $^9Be(\gamma,n)^8Be$ CROSS SECTION NEAR THRESHOLD. Barker, F. C.; Fitzpatrick, B. M. (Australian National Univ., Canberra). Aust. J. Phys., 21: 415-21(Aug. 1968).

Satisfactory fits to the $^9Be(\gamma,n)^8Be$ cross section just above the neutron threshold are obtained with the one-level approximation of R-matrix theory but not with that of complex eigenvalue theory. Restrictions on the R-matrix parameters from other sources are discussed. (auth)

48455 AN EXPERIMENTAL STUDY OF π^--NUCLEUS SCATTERING FROM 0.6 TO 1.6 GeV. Miller, Edward Standish. Princeton, N. J., Princeton Univ., 1967. 155p.

Thesis.

Measurements by counter techniques of the diffraction and absorption cross sections for the scattering of π^- mesons from nuclei are described. Results are given for twelve nuclei, Be, C, O, N, F, Na, Mg, Al, Cu, Zn, Ag, and Au, at six π^- kinetic energies from 600 to 1600 MeV, at twenty-four angles in the laboratory in the range 2° to 15°. On the basis of optical model fits to the measured cross sections, total absorption and elastic cross sections are evaluated. The optical model calculation was performed by numerically integrating the wave equation for as many partial waves as are necessary. Using nuclear size parameters which have been determined from electron scattering experiments, fits are made to the real and imaginary parts of the optical potential. The results for the fitted potentials are compared with potentials predicted from π-nucleon forward scattering amplitudes, including the effect of the Fermi momentum of the nucleons and multiple scattering corrections which depend on nucleon-nucleon correlations. The fitted values of the real potentials are generally in agreement with the values predicted from the π-nucleon amplitudes, however the cross sections are fairly insensitive to the value of the real potential so that the errors on the fitted values are large. With some exceptions, the more precisely determined imaginary potentials are in good agreement with the predicted values. The optical model fits are found for the most part to be

consistent with the size parameters determined from electron scattering experiments; in particular, a larger nuclear radius is not required. (Disser. Abstr.)

48456 INELASTIC SCATTERING OF 152-MeV PROTONS BY ^{12}C. Tatischeff, B. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 27B: 345-7(Aug. 19, 1968). (In French).

A method to evaluate the multiple scattering effects using the impulse approximation, that has been employed before for elastic scattering, is extended to inelastic scattering for levels with forward-peaked cross sections. (auth)

48457 RADIATIVE PION CAPTURE IN ^{16}O. Kawaguchi, M.; Ohtsubo, H.; Sumi, Y. (Osaka Univ.). Phys. Lett., 27B: 358-60 (Aug. 19, 1968).

The absolute values of the radiative capture rate in ^{16}O are predicted to be of order of 10^{17} sec^{-1} by the shell model calculation. The observed peak of the gamma ray spectra is interpreted as the giant resonance similar to that of the photo absorption. (auth)

48458 ELECTRIC-QUADRUPOLE CONTRIBUTION TO ^{16}O PHOTODISINTEGRATION. Erdas, F.; Quarati, P. (Univ., Cagliari, Italy. Univ. of Glasgow). Nuovo Cim., 57B: 238-42 (Sept. 11, 1968).

Photodisintegration of ^{16}O is analyzed by means of multipole sum rules, and the contribution from electric-quadrupole transitions is evaluated. (J.W.R.)

48459 OBSERVATION OF T = 0 AND T = 1 ALPHA-PARTICLE STATES IN ^{16}O BETWEEN E_x = 26 AND 29 MeV. Weller, H. R.; Van Rinsvelt, H. A.; Dunnam, F. E. (Univ. of Florida, Gainesville). Phys. Lett., 27B: 283-4(Aug. 5, 1968).

A measurement of the ^{13}C(^{3}He,$\alpha\gamma_{15.1}$)^{12}C reaction at bombarding energies below 8.0 MeV indicated three T = 1 states in ^{16}O between E_x = 26 and 29 MeV which were compared to the T = 0 states in the same region. (auth)

48460 ONE- AND TWO-NEUTRON TRANSFER REACTIONS INDUCED BY ^{18}O AND ^{19}F IONS. Falk, W. R.; Matter, U.; Huber, A.; Benjamin, R. W.; Marmier, P. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Phys., A117: 353-64(1968).

Excitation curves were determined from γ-ray yield measurements for four heavy-ion induced reactions involving the transfer of one or two neutrons. The incident heavy ions were ^{18}O and ^{19}F in the lab energy range from 12 to 30 MeV. Excitation curves are presented for the following reactions: ^{9}Be(^{19}F,^{20}F)^{8}Be, ^{9}Be(^{18}O,^{19}O)^{8}Be, ^{23}Na(^{18}O,^{17}O)^{24}Na and ^{23}Na(^{18}O,^{16}O)^{25}Na. The one-neutron transfer from ^{9}Be was characterized by a very large cross section as compared with other one-neutron transfer cross sections that have been reported, while the two-neutron transfer from ^{18}O to ^{23}Na had a cross section nearly as large as the one-neutron transfer. A theoretical curve was matched to the experimental curve for the ^{9}Be(^{18}O,^{19}O)^{8}Be reaction at energies below the Coulomb barrier, and from this comparison reasonable values for the single-particle reduced widths of the neutron in ^{18}O were obtained. (auth)

48461 THE j-DEPENDENCE OF THE VECTOR ANALYZING POWER IN THE ^{6}Li(d,p)^{7}Li REACTION. Fick, D.; Clausnitzer, G.; Duerr, W.; Fleischmann, R.; Hofmann, H. M.; Kilian, K. (Univ., Erlangen-Nuremberg). Phys. Lett., 27B: 366-7(Aug. 19, 1968).

For the ^{6}Li(d,p)^{7}Li reaction, where no j-dependence had been seen in the proton angular distribution, one can see a j-dependence in the angular distribution of the vector analyzing power. Compound nucleus effects are discussed. (auth)

48462 ^{6}Li(p,^{3}He)^{4}He REACTION WITH POLARIZED PROTONS FROM 0.4 TO 3.2 MeV. Brown, Louis (Carnegie Institution of Washington, D. C.); Petitjean, Claude Nucl. Phys., A117: 343-52(1968).

A polarized beam was used to measure the asymmetry in the angular distribution of the particles from the ^{6}Li(p,^{3}He)^{4}He reaction at 15 different energies from 0.4 to 3.2 MeV. The polarization efficiency can be fitted with associated Legendre polynomials. At 1 MeV and below the coefficient of P_1^1 is large and all other terms are negligible. Above 1 MeV, the coefficients of P_2^1 and P_3^1 are also significant. The data were measured typically to an accuracy of 2% with a target 30 keV thick at 1 MeV bombarding energy. A polarization contour map is given. The polarization is generally large and positive. (auth)

48463 GAMMA-RADIATION OF B, C, N, O, F, Al INDUCED BY 14 MeV NEUTRONS. Maslov, G. N.; Nasyrov, F.; Pashkin, N. F. At. Energ. (USSR), 24: 573-4(June 1968). (In Russian).

The hard portion of γ spectra (over 2 MeV) produced by the interactions of fast neutrons with some reactor materials was studied using NaI(Tl) spectrometers. Fast neutrons were obtained by bombarding a thick zirconium–tritium target with 150-keV deuterons. Cross sections were measured for the γ rays resulting from inelastic interactions of neutrons with Al, B, C, F, and O nuclei. The data were in good agreement with published data. (R.V.J.)

48464 ISOMERIC STATES ($T_{\frac{1}{2}} \geq 10^{-10}$ s) LISTED ACCORDING TO INCREASING HALF-LIFE. Kantele, J.; Tannila, O. (Univ. of Jyvaeskylae, Finland). Nucl. Data, Sect. A, 4: 359-95(July 1968).

Values of some 700 half-lives of isomeric states, ranging from 10^{-10} seconds to 10^6 years, are presented in order of increasing half-life. (auth)

48465 MASS DETERMINATION OF THE NUCLEI ^{12}N, ^{16}F, ^{22}Mg, AND ^{26}Si USING THE (^{3}He,n) REACTION. Adams, J. M. (Atomic Energy Research Establishment, Harwell, Eng.); Adams, A.; Calvert, J. M. J. Phys., A (London), 1: 549-52(Sept. 1968).

Fast neutron time-of-flight studies of (^{3}He,n) reactions were used to obtain information on the above four proton-rich nuclei. The ground-state reaction Q values, and hence atomic masses, and mass excesses, were determined together with the energies of several of the low-lying levels of these nuclei. The results are consistent with other recent determinations, but the values presented are more precise. In all cases there is disagreement with the 1964 Mass Tables. (auth) (UK)

48466 THREE-BODY MODEL OF THE ISOBARIC TRIPLET A = 6. Barsella, B. (Univ., Pisa, Italy); Lovitch, L.; Posati, S. Nucl. Phys., A117: 638-56(1968).

The ground state levels of ^{6}He and ^{6}Be and the corresponding J = 0 level of ^{6}Li are analyzed using a three-body (alpha particle plus two nucleons) model approximation. The local phenomenological alpha-nucleon potentials give a bound l = 0 state which proves to be present to a considerable degree in the three-particle wave function adopted. A procedure for eliminating such spurious components is derived and applied in the calculation of the binding energies of the isobaric triplet which results in reasonable agreement with the experimental values. The separation between ^{6}He and ^{6}Be due to Coulomb forces compares favorably with experiment and gives no indication of charge asymmetry in the two-nucleon interaction. (auth)

48467 MASS-18 NUCLEI. Nash, G. F. (Southampton Univ., Eng.). Nucl. Phys., A117: 615-24(1968).

A shell-model calculation was carried out for the singly excited states of mass-18 nuclei using the group SU_3 to classify the states. The effect of the spin-orbit coupling in mixing these states is examined, and the structure of the dipole resonances is elucidated. The division of the dipole strength from the various excited configurations to the ground state is calculated. The lowest of these dipole states is found to occur in the region of 12 MeV. (auth)

48468 LINEAR POLARIZATION OF SOME ISOTROPICALLY EMITTED GAMMA RAYS. Blake, R. S.; Johnson, G.; Laurent, H.; Shapira, J. P.; Picard, F. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A117: 561-74(1968).

Gamma rays emitted isotropically may be strongly polarized under special circumstances. A measure of the linear polarization of such a gamma ray or lack of it can help to eliminate several of the spin solutions which are consistent with the observed isotropy. By combining the results of linear polarization measurements with other published information, it was possible to show that the 2.00 MeV level in ^{11}C had spin $J^\pi = \frac{1}{2}^-$ and the 4.90 MeV level in ^{14}N has $J^\pi = 0^-$ (1$^-$). The parity of the 5.10 MeV level is negative. It thus has $J^\pi = 2^-$. (auth)

48469 REACTION ^{12}C(π^+,2p)d2α AT THE π^+-MESON ENERGY OF 117 MeV. Kosmach, V. F.; Kotov, A. A.; Ostroumov, V. I. Yadern, Fiz., 8: 32-7(July 1968). (In Russian).

The reaction ^{12}C(π^+,2p)d2α at the π^+-meson energy of 117 MeV was studied. The effective cross section of the reaction was found to be $18.6 \pm 2.8 \times 10^{-27}$ cm^2. Angular and energy distributions of the reaction products were analyzed; a conclusion about the mechanism of the absorption is made. (auth)

48470 INVESTIGATION OF TWO-STAGE CHANNELS OF THE (α,2α) REACTION OF THE Li ISOTOPES. Dolinov, V. K. (Inst. of Nuclear Physics, Moscow). Yadern, Fiz., 8: 26-31(July 1968). (In Russian).

Angular correlation functions $\alpha' - {}^3$H and $\alpha' - {}^3$H were measured for the reactions ^{6}Li(α,α')^{6*}Li $\rightarrow$ ^{4}He + ^{2}H and ^{7}Li(α,α')^{7*}Li $\rightarrow$ ^{4}He + ^{3}H, respectively. The measurements were performed at the energy of bombarding α particles E_α = 25 MeV using the technique of two-dimensional energy analysis. Experimental results are in qualitative agreement with theoretical ones obtained in the plane-wave approximation. In addition, angular distributions of α parti-

cles from the reactions $^{6}Li(\alpha,\alpha_0)$, $^{6}Li(\alpha,\alpha')$, and $^{7}Li(\alpha,\alpha')$ were measured. (auth)

48471 TEST OF TIME-REVERSAL INVARIANCE IN THE REACTION $^{16}O(d,\alpha)^{14}N$ AND ITS INVERSE. Thornton, S. T.; Jones, C. M.; Bair, J. K.; Mancusi, M. D.; Willard, H. B. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 21: 447-9(Aug. 12, 1968).

Time-reversal invariance was tested for by the principle of detailed balance in the reaction $^{16}O(d,\alpha)^{14}N$ and its inverse. Detailed balance was satisfied with an uncertainty of ±0.5%. (auth)

48472 INVESTIGATION OF THE $^{19}F(d,\alpha)^{17}O$ NUCLEAR REACTION IN THE ENERGY RANGE OF 450 TO 650 keV. Mesko, L.; Schlenk, B.; Valek, A. ATOMKI (At. Kut. Intez.) Kozlem., 10: 102-11(July 1968). (In Hungarian).

In the 459 to 645 keV bombarding energy range, in about 30-keV steps, the angular distributions of the α_0, α_1, α_2, and α_3 groups from the $^{19}F(d,\alpha)^{17}O$ nuclear reaction were measured. The experimental angular distributions are unsymmetrical to 90°, and the absolute cross sections of different α groups in the given energy range are nearly identical. Taking into account the shapes of α_2 angular distributions and their considerable independence of bombarding energy it can be concluded that in the given energy range the dominant reaction mechanism of the α_2 group has to be direct. One of the two nucleons picked-up in the course of this nuclear reaction by the bombarding deuteron has to originate from the ^{16}O core; and accordingly, the ^{16}O core seems to be "holed." (auth)

48473 REACTION $^{13}C(d,\alpha)^{11}B$ AT THE DEUTERON ENERGY OF 6.3 MeV. Denisov, A. E.; Kolalis, R. P.; Sadkovskii, V. S.; Teterin, E. D. Yadern. Fiz., 8: 265-6(Aug. 1968). (In Russian).

Angular distributions of α particles from the reaction $^{13}C(d,\alpha)^{11}B$ were investigated. (auth)

48474 EXPECTED REGIONS OF DELAYED α-RADIOACTIVITY. Fenyes, T.; Rupp, E. ATOMKI (At. Kut. Intez.) Kozlem., 10: 116-36(July 1968). (In Hungarian).

A necessary condition for the practical observability of the delayed α decay is the excitation of high energy levels of the nucleus, generally in the course of previous β decay, from which the probability of α decay can approximate or surpass the γ-decay probability. The heaviest isotopes of the elements, calculated on the basis of the Taagepera–Nurmia semi-empirical α-decay formula and the data of Myers–Swiatecki nuclear mass table, which energetically can lead, after β decay, to excited levels of the daughter nucleus with an α partial half-life of 10^{-14} sec. On some elements, calculations were carried out also for 10^{-12} and 10^{-16} sec α partial half-lives. (auth)

48475 REACTION $(\pi^+,2p)$ ON LIGHT NUCLEI OF THE 1p SHELL. Golovanova, N. F.; Zelenskaya, N. S. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 8: 274-85(Aug. 1968). (In Russian).

The parameters of the reaction $(\pi^+,2p)$ on nuclei of the 1p shell are studied assuming the reaction to be due to the direct mechanism of π meson absorption. Energy spectra of finite nuclei are studied specifically. Analyzing the spectra, one takes into account not only the nucleus states corresponding to the lowest configurations, but also highly excited states corresponding to configurations with destroyed internal s shell. When calculating probabilities of excitation of such hole states, spurious excitation on the center of nucleus mass is excluded. Comparison of the results with the experimental data shows that the binding energies of not only one-hole states but also of the two-hole states of nuclei with configuration $|s^2p^{n+2}\rangle$ can be determined in the reaction $(\pi^+,2p)$ at the π meson energy about 200 MeV. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 48207, 48441, 48455, 48460, 48463, 48464, 48474, 48507, 48509, 48510, 48512, 48519, 48592, and 48609.

48476 (IA-1102) NEUTRON CAPTURE GAMMA RAYS FROM NATURAL TITANIUM. Tenenbaum, J.; Arad, B.; Ben-David, G.; Moreh, R. (Israel Atomic Energy Commission, Tel Aviv). Jan. 1967. 34p. Dep.

Neutron capture gamma rays of Ti were studied using 30-cc and 10-cc coaxial Ge (Li) detectors. More than 65 lines, including about 25 new hitherto unknown lines, were identified. Energies and intensities were determined using the chlorine neutron capture gamma ray spectrum as a reference. (auth)

48477 (JAERI-1158, pp 17-20) NUCLEAR LEVELS OBSERVED BY (γ,γ') REACTION. Shikazono, Naomoto (Japan Atomic Energy Research Inst., Tokai). (In Japanese).

Nuclear resonant scattering of neutron-capture gamma rays is successfully used to study the highly excited nuclear levels near the neutron binding energy and also the low-lying levels fed by the inelastically scattered gamma rays. General considerations of resonant scattering of neutron-capture gamma rays and the study of elastic and inelastic scattering of lead-capture gamma rays from the 7368-keV level of ^{66}Zn are described. (auth)

48478 (JAERI-1158, pp 68-70) OCTUPOLE VIBRATION OF DEFORMED NUCLEI AND Y_3-DEFORMATION. Yamazaki, Takashi (Osaka Univ.). (In Japanese).

Energy levels of ^{20}Ne, especially experimental information on octupole vibrational bands and Y_3-deformational bands of ^{20}Ne, are reviewed. It is interesting to investigate systematically the coexistence of 3^- particle states and 3^- hole states in even-even nuclei. (auth)

48479 (JINR-P3-3956) RADIATIVE CAPTURE AND NEUTRON TOTAL CROSS SECTION FOR SELENIUM ISOTOPES. Maletski, Kh.; Pikel'nev, L. B.; Salamatin, I. M.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1968. 25p. (In Russian). Dep.

Radiative capture and transmission measurements were carried out on enriched Se isotopes, using the pulsed reactor IBR with a microtron. Level parameters were obtained in the energy range up to 10 to 20 keV for four even isotopes and up to 4 keV for an odd isotope. Spins were measured for 15 levels with $\Gamma_n > \Gamma_\gamma$ for ^{77}Se. Strength functions S_0, average level spacing, and average radiation widths $\bar{\Gamma}_\gamma$ were obtained. The spin dependence of S_0 and $\bar{\Gamma}_\gamma$ for ^{77}Se in the energy interval up to 4 keV was not observed. (auth)

48480 A COINCIDENCE STUDY OF THE $^{23}Na(d,n\gamma)^{24}Mg$ REACTION. Porterfield, Charles Delano. Charlottesville, Va., Univ. of Virginia, 1967. 114p.

Thesis.

Neutron-gamma time-of-flight studies were made of (d,nγ) reactions populating levels of ^{24}Mg with excitations of 9.283, 10.060, 10.347, 10.715, and 11.188 MeV, (designated subsequently as states A, B, C, D, and E, respectively). Angular distributions of neutrons from reactions populating states B, D, and E show distinctly l = 0 stripping patterns. The angular distribution from state A fits either l = 1 plus isotropic background of l = 1 plus l = 3 stripping curves equally well. The distribution from state C does not show a characteristic stripping pattern. Excitation curves taken for states B, D, and E were relatively smooth except for a well-defined resonance at 2.55 MeV in the curve for state D. A "gated" gamma spectrum indicates that state D decays strongly to low-lying 0^+ and 2^+ states. It is deduced from a comparison of a neutron gamma spectrum from this experiment with a pulsed-beam spectrum taken under similar conditions that all five of the states studied decay strongly ($\Gamma_\gamma \geq \Gamma_\alpha$) by gamma emission. Previous assignments of T = 1 to states B, D, and E and the spins that they imply are supported by the present study. A tentative assignment of $J^\pi = 3^-$ is made for state A, and the spin of state C is limited to J = 1, 2, or 3. Alpha emission by state D is estimated to have an inhibition factor of 20 or more. The problem of background count rates for this type of spectrometer has been considered in some detail. Sources of background are listed, and the distribution of background counts in a spectrum is discussed. The relative importance of various contributions to the accidental background are evaluated for typical conditions, and a scheme is proposed for determining the accidental background "dynamically." Straightforward statistical techniques are applied in analyzing the limitations imposed on the performance of pulse-shape discrimination circuits by pile-up and statistical fluctuations in pulse shapes. Insight is thereby gained as to the parameters necessary to specify, on an absolute scale, the performance of such a circuit. The manner in which the performance depends on count rates and pulse-height distribution is also exhibited. (Disser. Abstr.)

48481 DELAYED NEUTRON PRECURSORS. II. ANTIMONY AND ARSENIC PRECURSORS SEPARATED CHEMICALLY. Tomlinson, L.; Hurdus, M. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 30: 1649-61(Aug. 1968).

A high-speed chemical technique is described for separating antimony, arsenic, and germanium from fission products. The hydrides of these elements are formed inside a nuclear reactor by the Zn + H_2SO_4 reaction and are swept out by a fast gas flow. Further studies were made of delayed neutron emission from fission product isotopes of Sb and As formed in the thermal neutron fission of ^{235}U; the half-lives and delayed neutron yields are

in good agreement with those measured in an earlier study using an electrolytic technique. The weighted average values from the studies are as follows: half-lives (sec), ^{85,86}As 2.028 ± 0.012, ^{134}Sb 11.3 ± 0.3, ^{135}Sb 1.696 ± 0.021; absolute delayed neutron yields (neutrons/10^4 fissions), ^{85,86}As 9.7 ± 0.8, ^{134}Sb 0.028 ± 0.004, ^{135}Sb 3.5 ± 0.3. A search for other delayed neutron precursors of Sb, As, and Ge with half-lives down to 0.5 sec gave negative results. (auth) (UK)

48482 PARTICLE HOLE STATES IN ^{42}Ca EXCITED BY THE ^{41}K(^{3}He,d)^{42}Ca REACTION. Forster, J. S.; Bearpark, K.; Hutton, J. L.; Sharpey-Schafer, J. F. (Univ. of Liverpool). Phys. Lett., 27B: 285-7(Aug. 5, 1968).

Particle-hole states in ^{42}Ca up to an excitation energy of 5.79 MeV were determined. The states arising from the $(1d_{\frac{3}{2}}{}^{-1}, 1f_{\frac{7}{2}})$ configuration were identified and from the extracted spectroscopic factors spin assignments of 4^- and 2^- were made to the 3.95-MeV and 4.50-MeV levels. (auth)

48483 LEVELS EXCITED IN THE REACTION ^{58}Ni(p,t)^{56}Ni. Davies, W. G. (Nuclear Physics Lab., Oxford); Kitching, J. E.; McLatchie, W.; Montague, D. G.; Ramavataram, K.; Chant, N. S. Phys. Lett., 27B: 363-5(Aug. 19, 1968).

Angular distributions were obtained for triton groups in the reaction ^{58}Ni(p,t)^{56}Ni corresponding to levels up to 8.5 MeV excitation. Spin assignments are presented and the level structure of ^{56}Ni is discussed. (auth)

48484 POSSIBILITY OF A LARGE T = 2 COMPONENT IN THE GROUND STATE OF ^{26}Mg. Noble, J. V. (Univ. of Pennsylvania, Philadelphia). Phys. Lett., 27B: 361-2(Aug. 19, 1968).

The anomalous beta decay rate of ^{26}Al (0.229 MeV) can be explained by a large (~10%) T = 2 admixture in both parent and daughter states. Several experiments to directly measure the T = 2 component of the ^{26}Mg (daughter) ground state are suggested. (auth)

48485 THE g FACTOR OF THE 175-keV STATE IN ^{71}Ge AND HYPERFINE FIELDS OF ^{71}Ge IN Fe AND Ni. Morgenstern, J.; Schmidt, J. W.; Fluegge, G.; Schmidt, H. (Univ., Hamburg). Phys. Lett., 27B: 370-2(Aug. 19, 1968).

The spin rotation method was used to determine the nuclear g factor of the 175-keV state of ^{71}Ge and the hyperfine fields of ^{71}Ge in Fe and Ni. The measurements yielded g = +0.406 ± 0.004, H_{Hf}(Fe) = +70.0 ± 3.0 kG and H_{Hf}(Ni) = +33.0 ± 1.5 kG. (auth)

48486 INVESTIGATION OF A NEW E_x = 4 507 keV STATE IN ^{25}Al. Roepke, H.; Anyas-Weiss, N.; Litherland, A. E. (Univ. of Toronto). Phys. Lett., 27B: 368-9(Aug. 19, 1968).

An unbound state in ^{25}Al at E_x = 4507 keV was found as a resonance in the ^{24}Mg(p,pγ) reaction at E_p = 2330 keV. The partial widths of the state are restricted by $(2J + 1)\,\Gamma_p\Gamma_{p1}/\Gamma = 16 \pm 2$ eV and $(2J + 1)\Gamma_p\Gamma_\gamma/\Gamma \leq 1$ MeV. The angular distribution of the γ rays following proton inelastic scattering yields $J^\pi = \frac{5}{2}^+$ ($\frac{1}{2}$, $\frac{5}{2}$) for the ^{25}Al state. (auth)

48487 PROTON ELASTIC AND INELASTIC SCATTERING FROM ARGON AT 25 MeV. Johnson, R. R.; Griffiths, R. J. (Univ. of Colorado, Boulder). Nucl. Phys., A117: 273-88 (1968).

Protons were scattered from ^{36}Ar and ^{40}Ar at an incident energy of 24.85 MeV. The elastic scattering cross sections were analyzed in terms of the optical model. The angular distributions for inelastic scattering to several of the levels of ^{40}Ar and ^{36}Ar are compared with the predictions of the collective model using DWBA analysis. Distortion parameters, spins, and parities extracted are compared with previously obtained values and the level schemes are compared with theoretical predictions. (auth)

48488 NEUTRON TOTAL CROSS-SECTION MEASUREMENTS OF S AND Fe NEAR 2 MeV. Ferguson, J. M. (Naval Radiological Defense Lab., San Francisco). Nucl. Phys., A117: 472-80 (1968).

The neutron total cross sections of sulfur and iron were measured from 1.8 to 2.6 MeV with energy resolution of a few keV. The cross sections of both elements show fluctuations with widths of the order of 10 keV. For sulfur, the properties of the fluctuations are in good agreement with predictions based on the statistical variations of the compound nuclear levels. For iron, the measured amplitudes are somewhat lower than the prediction. (auth)

48489 A DWBA ANALYSIS OF POLARIZATION ANALYSING POWERS AND DIFFERENTIAL CROSS SECTIONS FOR THE (p,d) REACTION ON ^{28}Si AND ^{40}Ca. Chant, N. S.; Nelson, J. M. (Oxford Univ.). Nucl. Phys., A117: 385-406(1968).

The reactions ^{28}Si(p,d)^{27}Si and ^{40}Ca(p,d)^{39}Ca were studied using a 30.5-MeV polarized proton beam. For the ground-state transitions, polarization analyzing powers and differential cross sections were measured over a wide angular range. These data compared with DWBA calculations for which optical-model parameters were obtained from analyses of deuteron elastic scattering data for ^{27}Al and ^{40}Ca. Agreement between the theoretical and experimental (p,d) differential cross sections and analyzing powers for ^{28}Si(p,d)^{27}Si is good. For the ^{40}Ca(p,d)^{39}Ca reaction, reasonable agreement is obtained only by using a deuteron optical potential derived from a coupled-channels analysis of the (d,d) and (d,p) reactions on ^{40}Ca. (auth)

48490 THE ELASTIC SCATTERING OF ALPHA PARTICLES BY ^{40}Ca AT 12 TO 18 MeV. Robinson, Charles Paul. Tallahassee, Fla., Florida State Univ., 1967. 110p.

Thesis.

Sixty-four point angular distributions for the elastic scattering of alpha particles by ^{40}Ca were measured from 12 to 18 MeV in 100-keV intervals. The angular range was from 26.7 to 176.1° (cm). Optical model fits to these data were obtained using a Woods-Saxon real potential and a surface imaginary potential with a form given by the derivative of a Woods-Saxon function. The radius of the real well was set to a value of 5.2 F, consistent with electron scattering results. A representative set of angular distributions covering the entire energy range was fitted to establish a consistent set of the other geometric parameters. Two-parameter fits to all the data were then obtained by varying only the real and imaginary potential strengths. A fitting criterion which compensates for the large Rutherford contribution to the scattering at forward angles was found to give much improved fits. Of the ten phase equivalent potentials found for real potential strengths less than 210 MeV, the three with average values 25, 105, and 132 MeV were traced as functions of energy. A cluster model calculation for the potential required for a bound alpha particle s-state at −5.23 MeV in ^{44}Ti yields a well depth of 136 MeV, in rather good agreement with the 132 MeV average value found for the potential giving an 8-node s-wave radial wave function in the scattering analysis. This value is dependent on the chosen radius parameter according to $UR^2 \simeq$ constant in both the scattering and bound state cases. The value of UR^2 obtained is 3.65×10^3 MeV · F^2. (Diss. Abstr.)

48491 (p,xn) REACTIONS OF ^{56}Fe, ^{57}Fe, AND ^{58}Fe AT 370 MeV. Read, Jacques B. J. (Univ. of California, Livermore). Contract W-7405-eng-48. J. Inorg. Nucl. Chem., 30: 2039-46 (Sept. 1968). (UCRL-70764).

The (p,xn) cross sections of ^{56}Fe, ^{57}Fe, and ^{58}Fe producing ^{55}Co, ^{56}Co, and ^{57}Co were measured at 370 MeV by crossed bombardments of iron targets of different isotopic abundances. The ^{56}Fe(p,pn)^{55}Fe and ^{57}Fe(p,p2n)^{55}Fe reactions were found to have cross sections at 370 MeV of 58.4 ± 1.0 and 24.7 ± 2.3 mb, respectively. The (p,n) and (p,2n) cross sections are compared with others in the mass region A = 44 and A = 96. (auth) (UK)

48492 EVALUATION OF THE ^{57m}Fe NUCLEAR QUADRUPOLE MOMENT. Harris, C. B. (Univ. of California, Berkeley). J. Chem. Phys., 49: 1648-50(Aug. 15, 1968).

A value for the ^{57m}Fe nuclear quadrupole moment of 0.175 ± 0.02 was determined from a comparison of the quadrupole splittings in the Moessbauer data of ferrocene and the pure nuclear quadrupole resonance of ^{59}Co in cobalticinium perchlorate. The value is in good accord with recent calculations of Fe(II) complexes in the solid state. (auth)

48493 RELAXATION BEHAVIOR AND SCHMIDT CORRELATIONS FOR ODD–EVEN ISOTOPE PAIRS WITH I = $\frac{3}{2}$. Burkert, P. K.; Fritz, H. P. (Technische Hochschule, Munster, Ger.). Inorg. Nucl. Chem. Lett., 4: 477-81(Aug. 1968). (In German).

Wide-line nuclear resonance measurements on the isotope pairs ^{79}Br–^{81}Br, ^{63}Cu–^{65}Cu, and ^{35}Cl–^{37}Cl indicated that the relative ratios of the nuclear magnetic moments in terms of the corresponding Schmidt lines in the systematics of odd–even nuclei are in accordance with the reciprocal ratios of the relaxation times of these isotopes. (UK)

48494 NEW LEVELS IN ^{55}Co FROM THE ^{54}Fe(p,γ)^{55}Co REACTION. Maripuu, S. (Chalmers Univ. of Tech., Gothenburg, Sweden). Ark. Fys., 37: 97-105(1968).

The ^{54}Fe(p,γ)^{55}Co reaction was studied in the 1- to 2-MeV proton energy range. Nineteen resonances, corresponding to energy levels in ^{55}Co with excitation energies between 6 and 7 MeV, were found. The gamma-ray deexcitation was studied at six resonances. It has revealed six bound states with positions in accordance with earlier work. A level at 5.00 ± 0.05 MeV was not observed earlier. Branching ratios were calculated for six resonances levels and also for some bound states. (Sweden)

48495 SPINS OF ^{51}V LEVELS FROM INELASTIC NEUTRON SCATTERING. Towle, J. H. (AWRE, Aldermaston, Eng.). Nucl. Phys., A117: 657-72(1968).

The $^{51}V(n,n')$ reaction was studied using a time-of-flight spectrometer. Angular distributions were measured at 1.61 and 2.35 MeV, and excitation curves were measured at 0.2 MeV intervals from 1.0 to 3.8 MeV. These data are compared with calculations using Hauser–Feshbach theory including the correction for the fluctuation of compound-nuclear level widths, and excellent agreement is obtained. Level spins of $\frac{5}{2}$, $\frac{3}{2}$, $\frac{11}{2}$, $(\frac{9}{2})$, $\frac{3}{2}$, $\frac{1}{2}$, $(\frac{7}{2})$, and $\leq\frac{3}{2}$, respectively, are deduced for the ^{51}V levels at 0.320, 0.930, 1.609, 1.813, 2.409, 2.545, 2.675 and 2.790 MeV. These results are combined with data from other reactions to give a recommended ^{51}V level scheme which is then compared with the shell-model calculations of McCullen et al. and of Auerbach and the strong coupling (band-mixing) calculations of Scholz and Malik. (auth)

48496 $^{34}S(^3He,\alpha\gamma)^{33}S$ REACTION AND THE LOWEST T = $\frac{3}{2}$ STATES IN ^{33}S. Dubois, J. (Chalmers Univ. of Tech., Goeteborg). Nucl. Phys., A117: 533-44(1968).

Energy levels up to 7.5 MeV in ^{33}S were investigated by means of magnetic analysis of the alpha particles from the $^{34}S(^3He,\alpha\gamma)^{33}S$ reaction at 7 and 12 MeV bombarding energies. Angular distributions were measured, and the angular momenta transferred by the picked-up neutrons were determined from optical-model analysis using DWBA. The hole state created by picking up a neutron from the $1d_{\frac{3}{2}}$ orbit is suggested to be at 2870 ± 10 keV. The lowest T = $\frac{3}{2}$ states in ^{33}S were found at 5479 ± 15, 6900 ± 20 and 7348 ± 20 keV. The gamma decay of the 5479 keV level was investigated. (auth)

48497 ANALYSIS OF THE INELASTIC SCATTERING OF 50-MeV PROTONS. Lewis, V. E. (King's Coll., London); Calderbank, M.; Ganguly, N. K.; Fricke, M. P. Nucl. Phys., A117: 673-85(1968).

Differential cross sections and asymmetries for 50-MeV proton scattering from vibrational states in $^{64,66,68,70}Zn$, and ^{114}Cd were analyzed using a collective-model interaction obtained by deforming the entire optical potential. The strong single-phonon states (2^+ and 3^-) are well described, while predictions for weak two-phonon states are less successful. (auth)

48498 ENERGY DEPENDENCE OF SPIN FALL-OFF PARAMETER. Chaubey, A. K.; Sehgal, M. L. (Aligarh Muslim Univ., India). Nucl. Phys., A117: 545-51(1968).

Isomeric cross-section ratios were measured for ^{76}Ge, ^{108}Pd, ^{130}Te, and ^{164}Dy for 24-keV neutrons. Using the spin distribution in the form suggested by Bethe and Block, the isomeric cross-section ratios were calculated for the above cases as well as for ^{68}Zn, ^{80}Se, ^{79}Br, and ^{103}Rh and were compared with the measured ratios to determine the spin fall-off parameter. For ^{79}Br, ^{103}Rh, and ^{115}In, σ was calculated at different energies. It is found the $\sigma_{odd}/\sigma_{even} = 4.5 \pm 0.5$ for 24-keV neutrons. (auth)

48499 CROSS SECTIONS OF THE (n,p) AND (n,α) REACTIONS AT THE NEUTRON ENERGY OF 14.8 MeV. Levkovski, V. N.; Kovel'skaya, G. E.; Vinitskaya, G. P.; Stepanov, V. M.; Sokol'skii, V. V. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz., 8: 7-9(July 1968). (In Russian).

Twenty-four absolute cross sections of the (n,p) and (n,α) reactions of S, K, Ca, Sc, Fe, Co, Ni, Rb, Sr, Y, Cs, Ba, La, and Ce were measured by means of the activation method. (auth)

48500 NEUTRON POLARIZATION IN (d,n) REACTIONS ON NUCLEI WITH INTERMEDIATE ATOMIC WEIGHT. Levintov, I. I.; Okorokov, V. V.; Serezhin, V. M.; Smotryaev, V. A.; Tolchenkov, D. L.; Trostin, I. S.; Cheblukov, Yu. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 14-25(July 1968). (In Russian).

The polarization of neutrons from (d,n) reactions on the isotopes ^{59}Co, ^{56}Fe, $^{60,62,64}Ni$, and $^{64,66,68}Zn$ was measured for the angles 30 to 50° (lab. system). Deutrons with the energy 11.7 MeV were used (from the ITEP cyclotron). The neutron polarization was obtained from the azimuthal asymmetry of the scattering on carbon. The analyzing power of carbon was determined in the scattering of polarized neutrons from the $D(d,n)^3He$ reaction. Polarization of neutrons elastically scattered on carbon at an angle of 45° (l.s.) is found to be −0.78 ± 0.18 at E_n = 12.6 MeV and −0.60 ± 0.09 at E_n = 10.2 MeV. Spectra of the scattered neutrons were obtained by measuring the times of flight. The neutron polarization was measured for neutrons corresponding to the ground state and to the low-lying excited levels of the residual nucleus (the interval of the excitation energies $\Delta E^* \sim$ (0 to 3.1) MeV and (0 to 6.7 MeV). A systematically nonvanishing but small neutron polarization is observed. (auth)

48501 INVESTIGATION OF ANOMALIES IN THE ELASTIC SCATTERING OF 13.6-MeV DEUTERONS ON ATOMIC NUCLEI WITH N = 50. Korostova, I. N.; Sokolov, L. S.; Tokarevskii, V. V.; Chernov, I. P.; Yatis, A. A. Yadern. Fiz., 8: 10-13(July 1968). (In Russian).

Differential cross sections were measured for the elastic scattering of 13.6-MeV deuterons on the nuclei of Se, ^{86}Sr, ^{89}Y, ^{93}Nb, ^{96}Mo, and Ru in the region of angles from 10 to 170°. An enhancement of the diffraction structure in the angular distributions and an increase of the total elastic cross section are detected in the region of the filled neutron shell with N = 50 for the nuclei ^{86}Sr, ^{89}Y, ^{93}Nb. The angular distributions are analyzed in framework of the optical model. A correlation between the parameters of the optical model (W and a) and the anomalies in the angular distributions of the elastically scattered deuterons is observed. (auth)

48502 ELASTIC AND INELASTIC SCATTERING OF 25-MeV ALPHA PARTICLES BY ^{31}P, ^{32}S, AND ^{40}Ca. Budzanowski, A. (Inst. of Nuclear Physics, Krakow. Jagellonian Univ., Krakow); Hill, A. D.; Hodgson, P. E. Nucl. Phys., A117: 509-32(1968).

The cross sections for the elastic and inelastic scattering of 25-MeV alpha particles by ^{31}P, ^{32}S and ^{40}Ca were measured using a broad-range magnetic spectrograph and by semiconductor detector techniques. Angular distributions from 20 to 120° were obtained for the interactions exciting the states at 1.26 and 2.23 MeV in ^{31}P, at 2.24 and 5.01 MeV in ^{32}S and at 3.73 and 4.48 MeV in ^{40}Ca. These cross sections are analyzed with the adiabatic sharp cut-off model and by the coupled-channels model. The values of the deformation parameters are extracted and compared with those found in other investigations. (auth)

48503 RELATIVISTIC CORRECTIONS OF THE ANGULAR DISTRIBUTION OF THE NEUTRONS IN μ CAPTURE. Blokhintsev, L. D.; Zlatarov, V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 3, 100-6(May–June 1968). (In Russian).

Angular distributions and neutron spectra were calculated for the capture of polarized μ^- mesons by ^{40}Ca. Nuclear shells were used for describing protons while neutron–nuclear interactions were not considered. The calculations were made with and without consideration of velocity (relativistic) terms in the Hamiltonian of weak muon–nucleon interactions for two shell potentials: rectangular well and harmonic oscillator. It is shown that consideration of velocity terms does not influence the neutron spectra but changes considerably neutron angular asymmetry. (tr-auth)

48504 OBSERVATION AND CROSS SECTION OF THE REACTION $^{64}Zn(n,t)^{62}Cu$. Csikai, J.; Jost, K.; Szalay, A. (Inst. of Nuclear Research, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung., 24: 199-203(1968).

The existence of the $^{64}Zn(n,t)^{62}Cu$ reaction was confirmed and its cross section was determined to be 150 to 10 μb at 14.7-MeV neutron energy. A quick chemical separation technique permitted the measurement of the weak ^{62}Cu activity. The relatively high yield of the (n,t) reaction cannot be explained on the basis of the statistical model. (auth)

48505 INVESTIGATION OF THE GAMMA SPECTRUM IN THE DECAY OF ^{27}Mg BY Ge(Li) DETECTOR. Berenyi, D. (Inst. of Nuclear Research, Debrecen, Hungary); Varga, D.; Uchrin, J. Acta Phys. Acad. Sci. Hung., 24: 237-40(1968).

The energies and intensities of gamma rays in the decay of ^{27}Mg were studied by a Ge(Li) spectrometer. (auth)

48506 SPIN MIXING IN THE INITIAL CHANNELS OF THE REACTION $^{31}P(p,\alpha_0)^{28}Si$. Karadzhev, K. V.; Man'ko, V. I.; Chukreev, F. E. Yadern. Fiz., 8: 321-5(Aug. 1968). (In Russian).

Angular distributions of α particles from the reaction $^{31}P(p,\alpha_0)^{28}Si$ were used to determine the spin mixing coefficient defined as the ratio Γ_{p0}/Γ_{p1} where Γ_{p0} and Γ_{p1} are the proton partial widths for two possible channels of the reaction corresponding to the spin value 0 and 1. The distribution of these coefficients does not agree with the calculated quantities obtained with the assumption of the statistical independence of the widths Γ_{p0} and Γ_{p1} and with the Porter–Thomas distribution for each of them. The shape of the distribution points to a correlation between the widths. This correlation is rather close to that existing in case of the jj coupling. This fact may be interpreted as an indication that one may consider rather simple shell configurations even at the energies as high as those in the experiment (10.0 to 12.5 MeV). (auth)

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Refer also to abstracts 47074, 47317, 47346, 47347, 47402, 48202, 48415, 48441, 48455, 48464, 48474, 48481, 48497–48499, 48576, 48577, 48580–48583, 48587, 48592, and 48629.

48507 (ANL–7436) PHYSICS DIVISION SUMMARY REPORT, JANUARY–MARCH 1968. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 60p. Dep. CFSTI.

Research highlights include the development of a superconducting internal conversion electron spectrometer, with which the conversion spectrum of ^{181}Os was taken, and investigation of autoionization in H_2 by measurement of photoelectron energies. A number of investigations of nuclear energy levels by charged-particle reactions and scattering and by beta decay are summarized, together with optical-model analyses of the scattering of charged particles by light and medium-weight nuclei. Summaries of a number of papers that have been presented at meetings or have been accepted for publication are included. (D.C.W.)

48508 (APDA–218) EVALUATED NEUTRON CROSS SECTIONS OF ^{240}Pu FOR THE ENDF/B FILE. Pitterle, T. A.; Yamamoto, M. (Atomic Power Development Associates, Inc., Detroit, Mich.). June 1968. Contract AT(11-1)-865. 60p. (ENDF–122) Dep. CFSTI.

Data were evaluated from 10^{-4} to 15 MeV for the following neutron reactions: total, n–γ, fission, (n,2n), (n,3n), elastic scattering including Legendre polynomial expansions of the angular dependence, nonelastic, and inelastic scattering including resolved levels. Graphs of the evaluated data are included. (auth)

48509 (BMwF-FBK–68-22) ANNUAL REPORT, 1966. (Bonn Univ. (West Germany). Institut fuer Strahlen und Kernphysik). May 1968. 123p. (In German). Dep.

Information about the isochronous cyclotron under construction and the scientific work in the field of nuclear spectroscopy is given. (auth)

48510 (IA–1097) NUCLEAR SPECTROSCOPY USING RESONANCE SCATTERING OF CAPTURE GAMMA RAYS AT THE IRR-2 RESEARCH REACTOR. Schlesinger, Y.; Arad, B.; Ben-David, G. (Israel Atomic Energy Commission, Tel Aviv). Jan. 1967. 37p. Dep.

Studies of resonant scattering of capture gamma rays were carried out at a tangential beam tube at the IRR-2 reactor, using high-intensity gamma sources adjacent to the reactor core. The high fluxes of monoenergetic gamma rays available permitted the use of high-resolution germanium counters for studying elastic and inelastic transitions, thus giving information on decay schemes and on nuclear level parameters. (auth)

48511 (IA–1163) PRECISION STUDY OF HIGHLY EXCITED NUCLEAR LEVELS USING A GAMMA MONOCHROMATOR. Moreh, R.; Ben-Yaacov, G. (Israel Atomic Energy Commission, Tel Aviv). Feb. 1967. 34p. Dep.

A gamma monochromator using resonantly scattered neutron capture gamma beams, which was designed for study of highly excited nuclear levels, is described. Preliminary results concerning resonance levels in heavy nuclides are presented. (J.N.R.)

48512 (JAERI–1158) LOW-LYING STATES IN MEDIUM- AND HEAVY-MASS NUCLEI. Takekoshi, Eiko; Harada, Kichinosuke (eds.) (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). 1968. 144p. (In Japanese). Dep.

Separate abstracts were prepared for the 26 papers that were presented at the three-part conference dealing with the status of experimental studies, theory of collective motion, and nuclear structure in the fp-shell region. (D.C.W.)

For abstracts of individual papers see: 48477, 48478, 48513–48521, and 48573–48587.

48513 (JAERI–1158, pp 10-13) IN-BEAM SPECTROSCOPY IN THE INS. Ishihara, Masayasu (Tokyo Univ.). (In Japanese).

Light isotopes of Hg and Pb were studied using (p,4n) or (p,6n) reactions. Members of ground band quasi-rotational family were observed. Systematic trends of these isotopes are discussed. The reaction ^{197}Au (p, 2n)^{196}Hg was also investigated to find a 3^+ state. The 1386-keV state was assigned 3^+ from K/L values of de-exciting transitions. Angular distributions of electrons were observed, and their dependence on projectile energy was interpreted within the framework of statistical theory. The Re(p, xnγ)^{182}Os reaction was observed to investigate the anomalously reduced population of 8^- state in a heavy ion-induced reaction. (auth)

48514 (JAERI-1158, pp 14–16) LEVEL SCHEMES OF ^{150,152}Gd IN THE REACTION ^{151,153}Eu (p,2mγ). Gono, Yasuyuki (Tokyo Univ.). (In Japanese).

The level structures of ^{150,152}Gd were investigated by measuring the spectra of conversion electrons following ^{151,153}(p,2nγ) ^{150,152}Gd reactions. The levels at 1.227 (6^+), 1.280 (4^+), 1.668 ((6^+)) 1.745 MeV ((8^+)) of ^{152}Gd and 1.280 MeV (4^+) of ^{150}Gd are assigned (the numbers and the signs in parentheses indicate the spin and parity and double parentheses indicate their uncertainty). The properties of the beta-vibrational band are observed in the transitions of 0.614, 0.586, 0.525, (0.441) MeV in ^{152}Gd. (auth)

48515 (JAERI–1158, pp 21-5) HINDERED E1 TRANSITIONS IN DEFORMED ODD-A NUCLEI. Tamura, Tsutomu (Japan Atomic Energy Research Inst., Tokai). (In Japanese).

Experimentally determined E1 transition probabilities between the Nilsson orbitals $7/2^-$ (523) and $7/2^+$ (404) in odd Tm isotopes are compared with the predictions of the Nilsson model. The hindrance factors (T_γ(exp)/T_γ(Nilsson)) obtained are 1.3×10^2 and 5×10^2 for ^{167}Tm and ^{165}Tm, respectively. The large discrepancies of these values from the systematics of $\Delta K = 0$, E1 transitions (usually ≈ 1) were considered to be due to the effect of pairing correlations. (auth)

48516 (JAERI–1158, pp 31-8) SOME COMMENTS ON THE NUCLEAR STRUCTURE OF MEDIUM ODD-MASS NUCLEI. Inamura, Takashi (Inst. of Physical and Chemical Research, Tokyo). (In Japanese).

Gamma transitions in medium odd-mass nuclei are studied by referring to typical examples; ^{105}Pd, ^{117}In, and ^{129}Te. E1 transitions between low-lying excited states in the medium odd-mass nuclei are j-forbidden in the jj-coupling scheme. This infers that multiple major shells should be taken into account in interpreting these low-lying excited levels. It is of value to apply Nilsson model. An application of Kisslinger's intruder states faces difficulty in predicting B(E2) for a gamma transition from the intruder state in ^{125}Te. Possible deformed states and relating rotational states in these nuclei are discussed in view of the transition probability and its branching ratio. It is necessary to take special care in the case of the $K = 1/2$ rotational band; there is an additional intrinsic parameter b which enters into the expression of B(E2) like the intrinsic parameter in B(M1). One could find any consistency of these intrinsic parameters in the $K = 1/2$ rotational band. (auth)

48517 (JAERI–1158, pp 39-46) SYSTEMATICS OF COLLECTIVE STATES OF EVEN-EVEN NUCLEI IN THE RARE EARTH REGION. Matumoto, Zyun-Itiro; Takekoshi, Eiko (Japan Atomic Energy Research Inst., Tokai). (In Japanese).

Rotational energies of ground-state rotational bands, measured for even-even nuclei in the rare-earth region, are fitted by the usual rotational energy expansion, $E_I = AI(I+1) + BI^2(I+1)^2 + CI^3(I+1)^3 + DI^4(I+1)^4 \ldots\ldots$. Two (A, B), three (A, B, C), and four (A, B, C, D) parameters, obtained by means of several different approximations, are shown and are tabulated for some typical examples. These values are fairly sensitive to the choice of the approximation. The reliability of the results is discussed, and the degree of agreement with experimental data is compared with those obtained from Yoshizawa's empirical formula and Harris' formula (cranking model extension). Similar analyses are applied to fit rotational energies of β- and γ-vibrational bands. (auth)

48518 (JAERI–1158, pp 47-55) NUCLEAR STRUCTURE STUDY OF THE EVEN Sm ISOTOPES FROM THE (p,t) REACTION. Ishizaki, Y.; Sasaki, K.; Yoshida, Y. (Tokyo Univ.). (In Japanese).

For the purpose of investigation of the properties of nuclei which lie in the so-called transition region, ^{150,152,154}Sm(p,t) reactions were studied using a 55-MeV proton beam and a broad-range magnetic analyzer with an energy resolution of about 100 keV. The energy spectra and the angular distributions were measured. The (t,p) reactions to the same final states were studied by the Aldermaston and Copenhagen Groups. The results obtained by the (p,t) reactions are shown and are compared with the results obtained by the (t,p) reactions. Next, the properties of the energy levels of ^{150}Sm are discussed on the basis of the experimental data on the γ transitions given by Smither et al., in comparison with the results of the (t,p) and (p,t) measurements. (auth)

48519 (JAERI–1158, pp 56-63) SINGLE-PHONON 4^+ STATE IN SPHERICAL NUCLEI. Koike, Masahiro (Tokyo Univ.). (In Japanese).

Vibrational states in medium-weight, doubly even nuclei were investigated with inelastic scattering of protons. The states strongly excited by the 2^+-pole transition were observed. The angular distributions for these states were analyzed on the basis of the distorted-wave Born approximation. The first-order collective excitation was assumed for the interaction. Optical model parameters were adjusted to reproduce the angular distribution for the elastic scattering. The reduced transition ratio $B(E1)/B_{sp}$ was extracted. (auth)

48520 (JAERI–1158, pp 90-5) ANHARMONIC VIBRATIONS IN SPHERICAL EVEN-EVEN NUCLEI. Kishimoto, Teruo; Ikeda, Kiyomi (Tokyo Univ.). (In Japanese).

Studies of anharmonicities in the quadrupole vibration are reported. The quadrupole moments of the first 2^+ states, which have been recently measured by heavy-ion Coulomb excitation, give important guidelines for studies of anharmonic effects. The systematics of the quadrupole moments of these investigations are very important as a crucial test to various phonon models. The recently proposed model of anharmonic vibrations is summarized, and its relation with other works is discussed. (auth)

48521 (JAERI-1158, pp 123-4) THERMAL NEUTRON-INDUCED (n,α) REACTIONS. Okamoto, Koichi (Japan Atomic Energy Research Inst., Tokai). (In Japanese).

Several experiments on thermal neutron-induced (n,α) reactions have been done recently in the rare-earth region. Those results and preliminary results on ^{239}Pu, and ^{235}U (n,α) reactions are briefly surveyed. (auth)

48522 (LA-3917) A MULTILEVEL ANALYSIS OF THE ^{235}U FISSION CROSS SECTION. Cramer, James D. (Los Alamos Scientific Lab., N. Mex.). Apr. 16, 1968. Contract W-7405-eng-36. 9p. Dep. CFSTI.

Resonance parameters for the ^{235}U fission cross section, as measured on the Petrel experiment at the Nevada Test Site, were determined using a multilevel fitting program based on the Wigner-Eisenbud R-Matrix theory. (auth)

48523 (ORNL-TM-2211) COULOMB EXCITATION OF ROTATIONS AND VIBRATIONS IN EVEN-EVEN RARE EARTH NUCLEI. Sayer, Royce Orlando (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 235p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee [Knoxville].

The Coulomb excitation process was utilized to study rotational and vibrational states in the nuclei ^{152}Sm, ^{166}Er, and ^{172,174,176}Yb. The objectives of this investigation were to accurately measure: reduced transition probabilities within the ground-state rotational bands, reduced transition probabilities for excitation of vibrational states; and branching ratios for transitions from vibrational states to members of the ground state bands. These accurate measurements were needed to provide stringent tests for the nuclear models now in vogue for strongly deformed nuclei. Rotational states were primarily studied by means of multiple Coulomb excitation with 42 to 52 MeV ^{16}O ions. Both (Ge(Li)) and NaI detectors were used to observe the de-excitation γ rays in coincidence with projectiles scattered into an annular detector from thick targets. A computer program, which uses a modified version of the Winther-de Boer program as a subroutine, was written to calculate multiple Coulomb excitation yields for a thick target in order to analyze the data. The vibrational states were populated by bombarding thick targets with 11 to 15 MeV ^{4}He ions. Gamma-ray yield and angular anisotropy measurements were carried out with Ge(Li) detectors to obtain transition probabilities branching ratios, and E2/M1 mixing ratios for several $2' \rightarrow 2$ transitions. De-excitation γ rays from the 2^+, 4^+, and 6^+ levels in all five nuclei and from the 8^+ levels in ^{172,174,176}Yb were observed in ^{16}O-γ coincident spectra. The experimental ratio B(E2; $6 \rightarrow 4$)/B(E2; $2 \rightarrow 0$) is smaller than the symmetric rotator limit by about one standard deviation (±7 percent) for ^{172,174,176}Yb and by two standard deviations for ^{166}Er, whereas "centrifugal stretching" would produce ratios slightly larger than the rotator limit. The B(E2; $8 \rightarrow 6$)/B(E2; $2 \rightarrow 0$) ratio for ^{172,174,176}Yb is also smaller than the symmetric rotator limit by about one standard deviation (15-25 percent). Therefore, the experimental results do not bear out the classical centrifugal stretching model for strongly deformed nuclei. In the case of ^{152}Sm, the experimental ratio B(E2; $4 \rightarrow 2$)/B(E2; $2 \rightarrow 0$) is (12 ± 6) percent larger than the rotator limit. The B(E2; $6 \rightarrow 4$)/B(E2; $2 \rightarrow 0$) is also larger than, but still consistent with, the rotational value. It seems that "centrifugal stretching" effects are much more important for the transition nucleus ^{152}Sm than for nuclei in the middle of the rare earth region. The angular anisotropy measurements show that the 705-keV transition in ^{166}Er is > 99 percent E2, but that the 964-keV transition in ^{152}Sm is only (93^{+3}_{-4}) percent E2. This large M1 admixture in the 964-keV transition casts some doubt on the interpretation of the 1086-keV state in ^{152}Sm as a simple γ-vibration admixed with the ground state. In the case of the 811-keV level in ^{152}Sm, the experimental E2/M1 mixing ratio shows that the interband B(E2) branching ratios are not consistent with the treatment in which the β-vibrational band and the ground-state band wave functions are mixed. Three $J^\pi = 2^+$ levels which have not been reported in prior Coulomb excitation work were observed following bombardment of ^{172}Yb with 15-MeV ^{4}He ions. The level energies in keV are 1117.2, 1466.5, and 1609.7; and the B(E2) for excitation in single-particle units are 0.24, 1.31, and 0.56, respectively. However, the identification of the 1117-keV state must be regarded as quite tentative at present. (auth)

48524 (TID-24686) A COMPREHENSIVE BIBLIOGRAPHY ON NUCLEAR FISSION OF THE HEAVY ELEMENTS 1963-1967, ANNOTATED AND INDEXED. Ferguson, Joyce Bruner (Tennessee Univ., Knoxville). Dec. 1967. 242p. Dep. CFSTI.

Thesis.

In order to collect and organize recent literature on the subject of nuclear fission, an exhaustive search was made of three abstract journals published between January 1963 and June 1967. Those articles dealing with the physical phenomenon of fission itself, rather than with applications or consequences of the process, and published since January 1963 were assembled to form the bibliography which is the body of this thesis. Annotations were made where they were considered desirable, and author and subject indexes were compiled. A total of 1052 references were included, of which approximately 75 percent were obtained from Nuclear Science Abstracts, which was searched first. Most of the remaining 25 percent were found in Physics Abstracts and Chemical Abstracts, with a few references discovered in the supplementary sources mentioned in the text. (auth)

48525 BETA-GAMMA ANGULAR CORRELATION IN LIQUID ^{166}Ho SOURCES. Mellema, J.; van der Veen, P. H. (Rijksuniversiteit, Groningen, Netherlands). Nucl. Phys., A117: 376-84(1968).

An investigation of the time integral angular correlation 1780 keV β-81 keV γ in the decay of ^{166}Ho (27 h) was performed. The correlation attenuation factor for solid $HoCl_3$ sources was G_2 = 0.307 ± 0.004, while for sources of $HoCl_3$ dissolved in water G_2 = 0.755 ± 0.020 was obtained. The influence of source thickness on the β-γ anisotropy was investigated with the 2.3-MeV β-603 keV γ angular correlation in the decay of ^{124}Sb. The correction factors of Gimmi et al., are in good agreement with the results up to thicknesses of 4 mg/cm^2. (auth)

48526 THE DECAY OF ^{144}Pm AND THE ENERGY LEVELS OF ^{144}Nd. Raman, Subramanian (Oak Ridge National Lab., Tenn.). Nucl. Phys., A117: 407-18(1968).

The γ rays from ^{144}Pm were studied with 6-cm^3 and 30-cm^3 Ge(Li) detectors in singles and in coincidence with a 7.6 cm × 7.6 cm NaI(Tl) scintillation detector. Nine γ rays were observed. It is proposed that ^{144}Pm decay populates levels in ^{144}Nd at 2093 and 2203 keV in addition to the known levels at 696.6, 1314.4, 1510.2, and 1791.2 keV. The combined results now available on the even-parity states of ^{144}Nd from decay and reaction studies show limited agreement with the core-particle calculations of Heyde and Brussaard. The negative-parity states at ≈2.1 MeV may be members of a quintuplet formed by coupling an octupole phonon to a quadrupole phonon. (auth)

48527 (^{3}He,d) REACTIONS ON THE EVEN TIN ISOTOPES. Conjeaud, M.; Harar, S.; Cassagnou, Y. (CEN, Saclay, France). Nucl. Phys., A117: 449-71(1968).

Deuteron angular distributions from the (^{3}He,d) reaction on the even Sn isotopes leading to states of the corresponding odd Sb isotopes (A = 113 to 125) were studied at an incident ^{3}He energy of 18 MeV. DWBA calculations using the JULIE code were performed to assign l_p values and extract spectroscopic factors. On the basis of this analysis, levels were found carrying large fractions of the $1g_{\frac{9}{2}}$, $2d_{\frac{5}{2}}$, and $1h_{\frac{11}{2}}$ proton single-particle strength. The splitting of the $2d_{\frac{5}{2}}$ and $3s_{\frac{1}{2}}$ strength in many levels is more pronounced. Spacings and spectroscopic factors for the low-lying states are in fair agreement with calculations of Kisslinger and Sorensen. (auth)

48528 COLLECTIVE LEVELS IN LIGHT EVEN Ce ISOTOPES. Ward, David; Diamond, R. M.; Stephens, F. S. (Univ. of California, Berkeley). Nucl. Phys., A117: 309-20(1968).

The heavy-ion reactions (^{16}O,4n) and (^{20}Ne,4n) were used to populate levels in the neutron-deficient even cerium isotopes ^{126}Ce-^{128}Ce. Prominent γ rays in the "in-beam" spectra were assigned to transitions between the members of the ground-state quasi-rotational bands. The results show that as the number of neutrons decreases these isotopes tend towards rotational behaviour. The cross sections for the neutron evaporation reactions used were considerably reduced for the most neutron-deficient systems due to competition from charged-particle emission. Such competition prevented studying Ce isotopes lighter than ^{128}Ce by this method. (auth)

48529 APPLICATION OF INTERMEDIATE-COUPLING UNIFIED NUCLEAR MODEL TO ODD-MASS IODINE ISOTOPES. Rustgi, M. L. (State Univ. of New York, Buffalo); Lucas, J. G.; Mukherjee, S. N. Nucl. Phys., A117: 321-35(1968).

Employing the intermediate-coupling unified nuclear model, the properties of the low-lying levels of the odd-mass iodine isotopes are investigated. The electromagnetic transition probabilities and nuclear moments are also calculated. In most cases,

the results are found to be in fairly satisfactory agreement with the experimentally observed values. A number of energy levels are predicted which should stimulate new measurements. (auth)

48530 INTERNAL CONVERSION STUDIES OF THE 113-keV TRANSITION IN ^{177}Hf. Toernkvist, S.; Stroem, S.; Thun, J. E.; Schmidt, V.; Baade, N. (Univ. of Uppsala). Nucl. Phys., A117: 336-42(1968).

The multipole mixing of the 113 keV transition in ^{177}Hf was studied by measuring the directional correlations involving K-L_{II} and L_{III} electrons and by determining the K-conversion coefficient. All data are consistent giving $\delta = -3.1 \pm 0.6$. (auth)

48531 THE EVALUATION OF DIRECTIONAL CORRELATION EXPERIMENTS ON GAMMA-GAMMA CASCADES WITH MIXED M1-E2 TRANSITION. THE MIXING RATIO OF THE 675-keV TRANSITION IN ^{198}Hg. Uhl, Mario; Warhanek, Hans. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II, 175: 77-86(1966). (In German).

A statistically correct method for evaluating δ directional correlation experiments is derived. The γ-γ directional correlation of the 2^+(675 keV) 2^+(412 keV) cascade in ^{198}Hg was measured with conventional apparatus. The results are graphed according to the usual methods and according to the N and δ adaptation. (J.S.R.)

48532 THE CALCULATION OF THE 3^- STATE IN ^{208}Pb. Krainov, V. P. (Kurchatov Atomic Energy Inst., Moscow). Phys. Lett., 27B: 341-2(Aug. 19, 1968).

The energy, transition probability, wave function and static quadrupole moment are calculated for the 3^- state in ^{208}Pb by the method of finite Fermi systems. (auth)

48533 THE INNER BREMSSTRAHLUNG CORRECTION TO THE FIRST FORBIDDEN UNIQUE CORRELATION IN ^{144}Pr. Kemper, K. W.; Wilkinson, R. G. (Indiana Univ., Bloomington). Phys. Lett., 27B: 376-7(Aug. 19, 1968).

The inner bremsstrahlung contribution to the unique $\beta-\gamma$ correlation in ^{144}Pr was determined as a function of beta-ray energy. The corrected correlation agrees with the theoretical prediction for a first forbidden unique correlation to within 5%. (auth)

48534 THE ^{90}Zr AND ^{92}Mo(α,α') REACTIONS AT 31 MeV. Martens, E. J.; Bernstein, A. M. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Nucl. Phys., A117: 241-72(1968).

The ^{90}Zr and ^{92}Mo(α,α') reactions were studied at 31 MeV with 80-keV resolution and with an extremely small slit scattering tail associated with the elastic peak. Spin and parity assignments were made on the basis of the shapes of the differential cross sections by systematics and by comparison with distorted-wave Born approximation calculations. These assignments were made to an excitation energy of approximately 6 MeV in each nucleus. Three 2^+ states were found in each nuclide. Five 4^+ states were found in ^{90}Zr and three in ^{92}Mo. Four 3^- states were located in ^{90}Zr and six in ^{92}Mo. The cross sections of the higher 3^- states relative to the lowest 3^- states are 30% in ^{90}Zr and 57% in ^{92}Mo. The fractionation of the octupole strength found here was similar to that found previously in the $1f_{\frac{7}{2}}$ shell. The relative strengths of the lowest 3^- state in ^{90}Zr and ^{92}Mo were approximately equal. This differs from the situation in the Ca isotopes in which the octupole strength drops rapidly as A increases. The fractionation of the octupole strength is in qualitative agreement with theoretical estimates. (auth)

48535 RADIATIVE CAPTURE OF FAST NEUTRONS BY NUCLEI ^{122}Sn, ^{124}Sn, AND ^{121}Sb, ^{123}Sb. Tolstikov, V. A.; Koroleva, V. P.; Kolesov, V. E.; Dovbenko, A. G.; Shubin, Yu. N. At. Energ. (USSR), 24: 576-9(June 1968). (In Russian).

The activation method was used for measuring cross sections of the ^{122}Sn(n,γ)^{123}Sn, ^{124}Sn(n,γ)^{125}Sn, ^{121}Sb(n,γ)^{122}Sb, and ^{123}Sb(n,γ)^{124}Sb reactions at neutron energies of 0.3 to 2.7 MeV. The cross sections for radiative capture of fast neutrons were determined by using cross sections of slow neutron radiative capture: ^{122}Sn($T_{\frac{1}{2}}$ = 40 min), 0.180 ± 0.040 b, ^{124}Sn($T_{\frac{1}{2}}$ = 9.4 min), 0.140 ± 0.03 b; ^{121}Sb($T_{\frac{1}{2}}$ = 2.8 days), 6.5 ± 0.8 b; and Sb($T_{\frac{1}{2}}$ = 60.2 days), 2.5 ± 0.5 b. The results obtained were correlated with calculations by statistical reaction theory using the nuclear optical model for calculating neutron penetrability. Calculations of energy, spin, and parity of excited nuclear target levels were taken from published data. The neutron binding energies in the compound nuclei ^{122}Sb, ^{124}Sb, ^{123}Sn, and ^{125}Sn were taken to be 6.827, 6.45, 5.949, and 5.74 MeV, respectively. Level density parameters for ^{122}Sb and ^{124}Sb were taken to be 16.2 and 15.4 MeV, respectively; for ^{123}Sn and ^{125}Sn level densities were obtained as 16.3 and 14.6 MeV, respectively. At 0.2 to 0.9 MeV, the best agreement between theory and experiment was found at $\overline{\Gamma}_\gamma$ = 0.074 eV for ^{123}Sb and $\overline{\Gamma}_\gamma$ = 0.078 eV for ^{121}Sb. At the level densities considered, the cross sections for neutron absorption by ^{122}Sn and ^{124}Sn are in agreement with published data at $\overline{\Gamma}_\gamma$ = 0.1 eV for both cases. The calculations and experimental data were used to obtain isomer ratios for ^{122}Sn and ^{124}Sn at energies from 0.3 to 2 MeV. (R.V.J.)

48536 RECOIL STUDY OF THE SYMMETRIC FISSION OF ^{238}U BY 450-MeV PROTONS. Panontin, John A.; Porile, N. T. (Purdue Univ., Lafayette, Ind.). J. Inorg. Nucl. Chem., 30: 2027-37(Sept. 1968).

A thick-target recoil study of isobaric products with mass number 103 and 111 from the fission of ^{238}U by 450 MeV protons was performed. The results were analyzed to yield, for a given mass chain, the dependence on atomic number, Z, of the average cascade deposition energy, the average total kinetic energy release, and the average separation distance of the primary fragment charge centers. The average deposition energy increases by about 25 MeV per Z unit, whereas the other two quantities are essentially independent of Z. A correlation between the most probable value of Z for a given mass chain and the deposition energy leading to this product is derived on the basis of the unchanged charge distribution postulate. (auth) (UK)

48537 CHARGE DISTRIBUTION IN THE SYMMETRIC FISSION OF ^{238}U BY 450-MeV PROTONS. Panontin, John A.; Porile, N. T. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1505. J. Inorg. Nucl. Chem., 30: 2017-26(Sept. 1968). (COO-1505-21).

Cumulative cross sections of ^{111}Pd, ^{111}Ag, and ^{111}In, as well as of several other palladium and silver nuclides, were determined in the fission of ^{238}U by 450-MeV protons. The results were fitted to a Gaussian charge distribution. The analysis indicates that the neutron-to-proton ratio of the most probable product, N/Zp, has a constant value of 1.420 ± 0.003 for A = 103 to 112; the full width at half maximum of the distribution is 2.90 ± 0.10 Z units; the isobaric fission cross section in the region of symmetric fission is 68 ± 4 mbarn. (auth) (UK)

48538 PHOTOFISSION OF ^{209}Bi. Warnock, R. V.; Jensen, R. C. (San Diego State Coll., Calif.). Contract AT(04-3)-411. J. Inorg. Nucl. Chem., 30: 2011-16(Sept. 1968). (TID-24263).

The fragment yields of ^{91}Sr, ^{92}Sr, ^{91}Y, ^{93}Y, ^{97}Zr, ^{99}Mo, ^{105}Ru, ^{109}Pd, ^{112}Pd, ^{111}Ag, and ^{113}Ag were determined radiochemically for the photofission of ^{209}Bi by bremsstrahlung produced from 28-, 30-, 32-, 35-, 36-, and 40-MeV electrons impinging on a tungsten converter. A ^{65}Cu(γ,n)^{64}Cu reaction on thin copper foils served to measure the integrated photon dose. A symmetric mass-yield curve of about 19 mass units width was observed throughout the energy region studied. The total fission cross section increased from 1×10^{-8} barns at 28 MeV to 1×10^{-5} barns at 40 MeV. (auth) (UK)

48539 ALPHA HALF-LIFE OF ^{244}Cm. Bentley, William C. (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 30: 2007-9(Sept. 1968).

The alpha half-life of ^{244}Cm was measured by direct observation of the change in alpha counting rate of four samples over a period of seven years, and was found to be 18.099 ± 0.015 yr. (auth) (UK)

48540 FORBIDDEN BETA TRANSITION $\frac{1}{2}^+ \rightarrow \frac{3}{2}^-$ IN ^{99}Mo. Appalacharyulu, K. B.; Sastry, D. L.; Jnanananda, S. (Andhra Univ., Waltair, India). J. Phys., A (London), 1: 564-8(Sept. 1968).

The angular correlation of the $\frac{1}{2}^+ \xrightarrow{\beta} \frac{3}{2}^- \xrightarrow{\gamma} \frac{1}{2}^-$ cascade in ^{99}Mo decay was studied with a fast-slow scintillation spectrometer in the beta energy region 450 to 700 keV. A small negative beta-gamma anisotropy was observed, and the resulting angular correlation function $\epsilon(W)$ was found to lie between −0.023 and −0.034, with an uncertainty of about 25%. It is concluded that the results are in accordance with the ξ approximation applicable to certain non-unique first-forbidden beta transitions. (auth) (UK)

48541 DETERMINATION OF THE MULTIPOLARITY OF THE 0.3-sec ^{182}Ta ISOMERIC TRANSITION BY ITS L X-RAY PATTERN ALONE. Clark, David D.; Stabenau, Walter F. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 21: 925-8(Sept. 23, 1968).

The multipolarity of the short-lived isomeric transition in ^{182}Ta was determined to be M2 were measured, and population of the state from 16-min ^{182m}Ta was observed. Tentative spin and parity assignments were made. Determination of the multipolarity was by a new method which should have applicability to other cases of low-energy highly converted transitions in nuclides with Z > 60. (auth)

48542 ^{131}Sn, ^{133}Sn, ^{135}Sn, AND ^{136}Sn FROM FISSION: PURIFICATION, HALF-LIVES, AND ^{136}Sn GAMMA-RAY ENERGIES. Erdal, Bruce R.; Wahl, Arthur C. (Washington Univ., St. Louis). Contract AT(11-1)-1162. J. Inorg. Nucl. Chem., 30: 1985-93(Sept. 1968).

A new, rapid, and relatively simple procedure for separating

tin isotopes from all the other fission products was developed. The method is based on extraction of tin(II) into methyl isobutyl ketone from an aqueous sulphuric acid-potassium iodide solution and back-extraction of tin(IV) under the same conditions. The half-life values determined are generally consistent with previously reported values. The following values are recommended: ^{121}Sn: 27.0 ± 0.1 hr; ^{123}Sn: 40.1 ± 0.2 min, 129.3 ± 0.5 day; ^{125}Sn: 9.6 ± 0.1 min, 9.64 ± 0.03 day; ^{128}Sn: 59.3 ± 0.5 min. The energies of 12 γ-ray lines from ^{128}Sn in equilibrium with 10-min ^{128}Sb were determined with a germanium detector and are reported. (auth) (UK)

48543 DELAYED NEUTRON PRECURSORS. III. ^{87}Se. Tomlinson, L.; Hurdus, M. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 30: 1995-2002 (Sept. 1968).

A rapid method of separating fission product selenium is described, based on the formation of H_2Se; chemical yields of selenium in the range 0.4 to 2.6 per cent were obtained in 5.4 sec. By counting the neutrons from ^{87}Br (grown in from ^{87}Se), the half-life and cumulative fission yield of ^{87}Se were found to be 5.8 ± 0.5 sec and 1.17 ± 0.25 per cent, respectively. The fission yield agrees with that calculated for a normal type of charge distribution in the 87 mass chain. A short-lived neutron activity was observed, but it was not certain whether this was due to selenium or to contaminants. From the shape of the neutron decay curve an upper limit of ≤0.8 per cent was calculated for the neutron branching ratio (P(n)) for ^{87}Se. (auth) (UK)

48544 EVIDENCE FOR THE PRODUCTION OF COMPOUND NUCLEI WITH ATOMIC NUMBER 110. Sikkeland, T. (Univ. of California, Berkeley). Phys. Lett., 27B: 277-9(Aug. 5, 1968).

Angular correlation functions for coincident fragment pairs, the fission excitation function, and the most probable kinetic energy release for binary fission in the bombardment of ^{238}U with ^{40}Ar from the Berkeley HILAC were measured using a two-dimensional pulse-height analyzer in conjunction with a coincidence technique. Evidence is presented that compound nuclei of Z = 110 are produced in these reactions. (auth)

48545 THE RATIO OF THE EFFECTIVE CROSS SECTIONS FOR THE FORMATION OF A 608-μ SEC ISOMER AND THE GROUND STATE OF ^{202}Tl BY (n,2n) REACTIONS WITH 14-MeV NEUTRONS. Scheimbauer, P.; Hille, P. Oesterr. Akad. Wiss., Math.-Naturwiss. K., Sitzungsber., Abt. II, 163-70(1966). (In German).

Natural Tl was irradiated with 14-MeV neutrons produced in pulsed operation of the neutron generator. In the reaction ^{203}Tl(n,2n)^{202}Tl, an isomeric nuclear state is produced; and the measurement of its half-life gave a value of $T_{\frac{1}{2}}$ = 608 ± 22 μ sec. From the ratio of the γ activities of the isomer and the ground state, the ratio $\sigma_i/(\sigma_i + \sigma_g)$ = 0.34 ± 0.044. From the ratio of these effective cross sections, the value σ = 3.7 ± 0.4 was obtained by the Huizenga and Vandenbosch method for the spin distribution parameter. (tr-auth)

48546 ENERGY LEVELS IN THE SINGLE CLOSED SHELL NUCLEUS ^{137}Cs POPULATED IN THE DECAY OF 4-min ^{137}Xe. Holm, Goeran (Research Inst. of National Defence, Stockholm. Research Inst. for Physics, Stockholm). Ark. Fys., 37: 1-11 (1968).

The decay of ^{137}Xe were studied with an on-line isotope separator technique. The data from lithium-drifted germanium detectors and scintillation coincidence measurements were used to plot a level scheme of ^{137}Cs. The ground state and the first excited state were interpreted as the $g_{\frac{7}{2}}$ and $d_{\frac{5}{2}}$ states. All other excited states are populated by extremely weak transitions in agreement with what can be expected for a single closed shell nucleus. (Sweden)

48547 STUDY OF PHOTONEUTRON REACTIONS ON ^{181}Ta. Veyssiere, Andre; Beil, Hans; Bergere, Roland (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. A and B, 267: 234-6(July 15, 1968). (In French).

The study of the photonuclear reactions (γ,n), (γ,2n), (γ,3n), and (γ,4n) on ^{181}Ta allows one to show that 22 ± 2% of the neutrons produced by the reaction (γ,n) by gammas of energy between 14 and 18 MeV are due to a direct interaction, whereas all the neutrons produced by the reactions (γ,2n), (γ,3n), and (γ,4n) are evaporation neutrons. (tr-auth)

48548 NEGATON DECAY OF ^{122}Sb. Hsue, S. T.; Kim, M. U.; Langer, L. M.; Piel, W. F. Jr.; Spejewski, E. H. (Indiana Univ., Bloomington). Nucl. Phys., A117: 686-96(1968).

The negaton spectrum in the decay of ^{122}Sb was investigated using a 180° shaped magnetic-field spectrometer. The energy signature technique was employed in order to discriminate against background and instrumentally scattered electrons. The spectrum shape factor for the $2^- - 2^+$, 1414-keV beta transition of ^{122}Sb is essentially statistical within the experimental errors. The result of this shape measurement makes it possible to limit the number of solutions for the six nuclear matrix elements which enter into this once-forbidden non-unique transition. Only three beta groups were observed, and their end-point energies (keV), intensities and $\log_{10}$ft values are: 723 (4.0 ± 0.5%, 7.7) 1414 ± 3 (69.0 ± 0.2%, 7.6), and 1980 ± 3 (27.0 ± 0.2%, 8.6). (auth)

48549 RADIOCHEMICAL DETERMINATION OF THE ALPHA HALF-LIFE OF ^{241}Am. Stone, R. E.; Hulet, E. K. (Univ. of California, Livermore). Contract W-7405-eng-48. J. Inorg. Nucl. Chem., 30: 2003-5(Sept. 1968). (UCRL-70856).

The alpha half-life of ^{241}Am was determined by the measurement of the specific activity of samples prepared from high-purity ^{241}Am metal. Low-geometry alpha counting of 28 samples taken from solutions of the dissolved metal gave a specific activity of 7.541 × 10^6 α-dis/min μg, and a half-life of 436.6 ± 3.0 yr. A revised value for the beta half-life of ^{241}Pu, the precursor of ^{241}Am, was calculated to be 14.0 ± 0.3 yr. (auth) (UK)

48550 RELATIVE INTERNAL CONVERSION COEFFICIENTS FOR γ TRANSITIONS OF THE NUCLEUS ^{180}Hf. Gvozdev, V. S.; Grigor'ev, V. N.; Sergeenkov, Yu. V. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 8: 3-6(July 1968). (In Russian).

Energies and the relative internal conversion coefficients (ICC) for γ transitions of the nucleus ^{180}Hf were measured. The transition with the energy 500.57 keV is shown to be reasonably described by the mixture of the multipolarities: (9 ± 1) % M2 and (91 ± 1) % E3. For the transition with the energy 57.54 keV, the data obtained confirm the conclusion that the values of ICC for this transition with E1 multipolarity are abnormal and can not be explained by a mixture of other multipolarities with the same parity. For the pure E2 transitions of the rotational band with the energies 93.33, 215.27, 332.26 and 443.09 keV, the relative ICC, measured up to 5 to 10%, do not differ from the theoretical values. (auth)

48551 LEVELS OF ^{208}Po FROM RADIOACTIVE DECAY AND NUCLEAR REACTION γ-RAY SPECTROSCOPY. Treytl, William J.; Hyde, Earl K.; Yamazaki, Toshimitsu (Univ. of California, Berkeley). Nucl. Phys., A117: 481-508(1968).

Information obtained from a study of the radioactive decay of 1.7 h ^{208}At and from on-line studies of the γ-radiations emitted by ^{208}Po produced in ^{209}Bi(p,2n), ^{206}Pb(α,2n) and ^{205}Pb(α,4n) reactions was used to construct a decay scheme for ^{208}At and a level scheme for ^{208}Po. Many of the low-lying levels can be explained on the basis of the known levels of ^{206}Pb and ^{210}Po and the weak coupling approximation. Among the interesting features of the scheme is a 380 nsec state which is identified as the 8^+ member of the band of levels resulting from the proton configuration $(h_{\frac{9}{2}})^2$. (auth)

48552 MEAN LIFETIMES OF THE 4^+ LEVELS IN ^{158}Dy AND ^{164}Er. Ben-Zvi, I.; Blaugrund, A. E.; Dar, Y.; Goldring, G.; Hess, J.; Sachs, M. W.; Skurnik, E. Z.; Wolfson, Y. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., A117: 625-37(1968).

The mean lifetimes of the 4^+ levels in the ground-state rotational bands of ^{158}Dy and ^{164}Er were measured. Both levels were excited through (p,2n) reactions. The lifetime of the level in ^{158}Dy was measured using a recently developed multichannel version of the microwave method. The measurement in ^{164}Er was carried out with the earlier version of the microwave technique. The results of these measurements are τ(^{158}Dy) = 108 ± 12 ps and τ(^{164}Er) = 124 ± 12 ps. The B(E2;$4^+ \rightarrow 2^+$) values are compared with the corresponding B(E2; $2^+ \rightarrow 0^+$) values and are found to be in agreement with the rotational model. (auth)

48553 RECOILLESS RESONANCE ABSORPTION AND HYPERFINE STRUCTURE OF THE 6.2-keV STATE IN ^{181}Ta. Sauer, C.; Matthias, E.; Moessbauer, R. L. (Technische Hochschule, Munich). Phys. Rev. Lett., 21: 961-4(Sept. 30, 1968).

A strong recoilless resonance absorption was observed for the 6.2-keV level ($T_{\frac{1}{2}}$ = 6.8 μsec) of ^{181}Ta. Using sources of ^{181}W in W-metal and Ta-metal absorbers, a line-width of 11 times natural width was obtained, with isomer shifts in the range between 0.83 and 0.94 mm/sec, depending on the quality of the sources. From the hyperfine splitting in a longitudinal magnetic field the magnetic moment of the 6.2-keV level was determined to be μ_1 = +5.14 ± 0.15 μ_N. (auth)

48554 METHOD OF SPIN ASSIGNMENT OF NEUTRON RESONANCES BASED ON CAPTURE GAMMA-RAY DETECTION. Coceva, C. (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy); Corvi, F.; Giacobbe, P.; Carraro, G. Nucl. Phys., A117: 586-614(1968).

In a time-of-flight neutron spectrometer, capture gamma rays

were detected by two NaI(Tl) crystals. Single and coincidence counts were registered separately. It is shown that, with a proper choice of the energy threshold for single counts, the ratio of singles to coincidences in an s-wave resonance of a given nucleus is characteristic of the spin of the level. The interpretation of the experiment is supported by a numerical simulation of the gamma decay process. Experimental results are presented for odd-neutron target nuclei with spin $I = 5/2$ and $I = 7/2$. Spins were assigned to 50 resonances in ^{105}Pd, 36 resonances in ^{99}Ru and ^{101}Ru, 24 resonances in ^{95}Mo and ^{97}Mo, and 46 resonances in ^{177}Hf. Isotopic identification of resonances was performed in Pd and Ru. An indication of variation with spin of the s-wave neutron strength function in the direction $S(I + 1/2) > S(I - 1/2)$ is found for ^{177}Hf(n,γ). The comparison of the level densities of the two spin states gives a lower limit for the spin cut-off parameter $\sigma_{min} = 3.3$ for the compound nucleus ^{106}Pd and $\sigma_{min} = 3.1$ for ^{178}Hf. (auth)

48555 MULTIPARAMETER INVESTIGATION OF ANISOTROPY OF γ QUANTA EMISSION AT ^{235}U FISSION. Ivanov, O. I.; Kushnir, Yu. A.; Smirenkin, G. N. Yadern, Fiz., 8: 50-5(July 1968). (In Russian).

The two-dimensional dependence of the anisotropy of γ quanta emission at the ^{235}U fission on the kinetic energy and on the ratio of fragment masses was measured using silicon counters and a scintillation detector. An increase of anisotropy with the kinetic energy of fragments confirms the electrostatic origin of the fragment angular momenta. (auth)

48556 LONG-RANGE PARTICLES WITH Z > 2 AT THE TERNARY FISSION OF ^{235}U BY THERMAL NEUTRONS. Andreev, V. N.; Nedopekin, V. G.; Rogov, V. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 8: 38-49(July 1968). (In Russian).

Emission of particles with Z > 2 in the fission of ^{235}U by thermal neutrons was studied. Particles were registered by means of a detector measuring for each particle dE/dx, E, and R, simultaneously. Li, Be, B, C, N, O, and F were found with the yields from 4.13×10^{-6} up to 2.1×10^{-5} nuclei per fission. Ion energetic spectra are measured and their isotopic composition is estimated. Preferable emission of elements with even Z and of isotopes with even N is found. Ion spectra are calculated at the moment of their production during the fission process. (auth)

48557 LOW-ENERGY PART OF THE α-PARTICLE SPECTRUM FROM TRIPARTITION OF ^{235}U. Chwaszczewska, J.; Dakowski, M.; Krogulski, T.; Piasecki, E.; Sowinski, M.; Stegner, A.; Tys, J. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol., 34: 173-5(July 1968).

The low-energy part of the spectrum of α particles emitted in thermal neutron fission of ^{235}U was measured using a telescope counter. The upper limit for the cross section of the ^{235}U(n,α) ^{232}Th reaction, was estimated to be 3 mb for the transition to the ground state and 2 mb for the transition to the excited state up to 5 MeV. (auth)

48558 MEASUREMENT OF THE NEUTRON FISSION AND CAPTURE CROSS SECTIONS FOR ^{233}U IN THE ENERGY REGION 0.4 TO 2000 eV. Weston, L. W. (Oak Ridge National Lab., Tenn.); Gwin, R.; deSaussure, G.; Fullwood, R. R.; Hockenbury, R. W. Nucl. Sci. Eng., 34: 1-12(Oct. 1968).

The neutron capture cross section and fission cross section for ^{233}U were measured simultaneously in the neutron energy range 0.4 to 2000 eV. A pulsed and collimated neutron beam was passed through a ^{233}U fission chamber placed at the center of a large liquid scintillator. Capture and fission events in the ^{233}U chamber were detected in the scintillator by means of their prompt gamma rays. Coincident signals from the fission chamber and liquid scintillator distinguished fission from capture events. Comparisons with previously published data, using similar and different methods, are given. (auth)

48559 CROSS SECTIONS FOR THE REACTIONS ^{141}Pr(n,p)^{141}Ce, ^{141}Pr(n,t)^{139}Ce, ^{142}Ce(n,2n)^{141}Ce, AND ^{140}Ce(n,2n)^{139}Ce. Csikai, J.; Fominich, V. I.; Lakatos, T. (Inst. of Nuclear Research, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung., 24: 233-6(1968).

Absolute activation cross sections for the reactions ^{141}Pr(n,p), ^{141}Pr(n,t), ^{142}Ce(n,2n), and ^{140}Ce(n,2n) were determined at 14.8-MeV neutron energy, using a Ge(Li) spectrometer. The results are in good agreement with the data calculated on the basis of empirical relations. (auth)

48560 MEASUREMENTS ON THE EXCITATION CROSS SECTIONS OF ISOMERIC STATES BY SCATTERING OF 2.8-MeV NEUTRONS. Bornemisza-Pauspertl, P.; Kdrolyi, J.; Petoe, G. ATOMKI (At. Kut. Intez.) Kozlem., 10: 112-14(July 1968).

The applicability of the D + d neutrons for activation analysis was tested by measuring activation cross sections for neutron inelastic scattering by ^{135}Ba, ^{137}Ba, ^{197}Au, ^{115}In, ^{191}Ir, and ^{199}Hg at 2.8 MeV. Half-lives were measured for the isomeric states excited by the scattering. (J.W.R.)

48561 ENERGY AND MASS DISTRIBUTION OF FRAGMENTS AT THE FISSION OF ^{235}U BY MONOENERGETIC NEUTRONS IN THE ENERGY INTERVAL 0 TO 15.5 MeV. D'yachenko, P. P.; Kuz'minov, B. D.; Tarasko, M. Z. Yadern. Fiz., 8: 286-96 (Aug. 1968). (In Russian).

The results of an investigation of the mass and energy distribution of fragments at the fission of ^{235}U by monoenergetic neutrons in the energy interval from 0 up to 15.5 MeV are presented. The data were obtained by the method of simultaneous measurement of the pair fragment energies by silicon surface-barrier detectors. The measurements are discussed in the framework of existing models of fission. It is noted that some properties of energy and mass distributions of fragments may be understood in the framework of the statistic model of the fission. It is concluded that the shell effects did not change their influence on the fission process with the energy increase of bombarding neutrons at least up to $E_n = 6$ to 7 MeV. (auth)

48562 DEPENDENCE OF THE γ-RAY ANISOTROPY FOR SLOW-NEUTRON FISSION OF ^{235}U ON THE TOTAL FRAGMENT KINETIC ENERGY AND ON THE FRAGMENT MASS RATIO. Val'skii, G. V.; Petrov, G. A.; Pleva, Yu. S. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 8: 297-304(Aug. 1968). (In Russian).

The γ intensity for the quanta with energy greater than 100 keV emitted as a result of the slow-neutron fission of ^{235}U was measured at angles of 30° and 90° to the direction of separation of the fragments. The ratio of the two intensities was obtained as a quantity depending on the total kinetic energy and on the fragment mass ratio. It is found that the radiation anisotropy increases somewhat with the kinetic energy and does not depend (within the experimental errors) on the mass ratio. The results are discussed in view of various assumptions about origin of the angular momenta of the fragments. Relative yields of the γ quanta at the fission are also considered as functions of the kinetic energies and mass ratio of the fragments; yields of the γ quanta from heavy and light fragments, separately, are estimated. (auth)

48563 N-FORBIDDEN β TRANSITIONS IN DEFORMED NUCLEI IN THE APPROXIMATION OF FINITE POTENTIAL WITH DIFFUSE EDGE. Gareev, F. A.; Kalinkin, B. N.; Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 8: 305-12(Aug. 1968). (In Russian).

N-forbidden β transitions in deformed nuclei of the rare-earth region are considered. For the wave functions of states involved in the transition, one uses solutions of a one-particle problem for a finite potential with a diffuse edge (Saxon–Wood potential) which takes into account the admixtures of states from the shells $N \pm 2$. The effects of superfluidity are also taken into account. Unlike the Nilsson scheme, according to which the probabilities of such transitions are zero, finite values for log ft are obtained. Comparison with experiments gives reasonable agreement. (auth)

48564 GAMMA SPECTROMETRIC DETERMINATION OF THE ACTIVITY RATIO BETWEEN ^{228}Th AND ITS DECAY PRODUCTS. I. CALCULATION OF THE ACTIVATION RATIO FROM PULSE-HEIGHT SPECTRA. Kaul, A.; Heyder, J. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main). Biophysik, 5: 91-8(1968). (In German).

A mathematical method is described which allows the calculation of the ^{224}Ra and ^{212}Pb activities of samples at the time of extirpation or the activity ratios between ^{228}Th and both these decay products by the variation with time of the ^{208}Tl activities of extirpated tissue samples containing thorotrast. The variation of the ^{208}Tl activity of each sample is determined by gamma-ray-spectrometry at least three times within a time interval of 30 days after extirpation. The error of the activity ratios estimated by this method was calculated by measurement of spleen samples from rabbits each with a thorotrast body burden of 2 ml. (auth)

48565 INVESTIGATION OF THE DECAY OF ^{166}Tm ($T_{1/2}$ = 7.7 HRS). Miminoshvili, Z. N.; Sorokin, A. A. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 8: 217-26(Aug. 1968). (In Russian).

In order to investigate the ^{166}Tm → ^{166}Er decay scheme, the e–γ and γ–e coincidences were measured by means of the Si(Li) detector and the NaI(Tl) crystal. Relative intensities of γ rays from five weak transitions in ^{166}Er and the conversion coefficients were determined, and the multipolarities were established. A new level with energy 2388 keV is introduced as a start for the transitions with energies of 928, 226, and 170 keV. Spins and parities of the levels 1460 and 1941 keV, $(2^-,2)$ and $(2,3^+)$, respectively, are confirmed. The 1433-keV transition is established to occur

from 2293- to 860-keV levels. Spin and parity $(2,3^+)$ are assigned to the level 2293 at keV. Relative intensities of three groups of γ rays with energies greater than 2200 keV were determined. (auth)

48566 INVESTIGATION OF α RADIOACTIVITY OF THE Sm ISOTOPES. Korolev, V. A.; Alkhazov, G. D.; Vorob'ev, A. A.; Egorov, A. I.; Vasil'eva, L. M. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 8: 227-34(Aug. 1968). (In Russian).

Alpha spectra of the Sm natural isotope mixture as well as of the mixture enriched by the isotopes ^{148}Sm, ^{149}Sm, and ^{147}Sm were measured by means of a double flat ionization chamber. The α radioactivity of ^{148}Sm was found to be $E_\alpha = 1.90 \pm 0.05$ MeV and $T_{1/2} = 8 \pm 2 \times 10^{15}$ years. For the half-life of ^{149}Sm, the lower limit is established to be $T_{1/2} > 10^{16}$ years for $E_\alpha < 2.0$ MeV. The fine structure in the ^{147}Sm spectrum is not detected. It is shown that the intensity of transitions to excited states is <0.01% at $E_\alpha < 1.5$ MeV; <0.1% for 1.5 MeV $< E_\alpha <$ 2.0 MeV; and <0.5% for 2.0 MeV $< E_\alpha <$ 2.17 MeV. (auth)

48567 INVESTIGATION OF EXCITED STATES OF ^{140}Ce WITH THE ENERGY MORE THAN 2.5 MeV BY PAIR-CONVERSION POSITRONS. Belyaev, B. N.; Vasilenko, S. S.; Gvozdev, V. S. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 8: 235-9(Aug. 1968). (In Russian).

The pair-conversion positrons resulting from the decay of ^{140}La obtained in the (n,γ) reaction were investigated. The multipolarities of the following transitions were determined by the value of the α_π/α_K ratio: 2522 (E2), 2900 (E2,M1), 3123 (E2,M1), and 3322 keV (E2,M1). As a result, the following spins and parities are ascribed to the levels of ^{140}Ce: 2^+; 2^+; 1^+ and 2^+, 1^+. The excited states of ^{140}Ce with energies of 2900, 3123, 3322 keV are interpreted in framework of the two-quasiparticle model by the multiplets on the nucleon shells $(d_{\frac{5}{2}})^2$ and $(s_{\frac{1}{2}},d_{\frac{5}{2}})$. (auth)

48568 INVESTIGATION OF RADIATION FROM ^{73}Se. Akhmed, M. R.; Baskova, K. A.; Vasil'ev, S. S.; Shavtvalov, L. Ya. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz., 8: 240-6(Aug. 1968). (In Russian).

The β spectrum of ^{73}Se isomers was measured by means of a magnetic spectrometer. The partial β spectra: 1700, 1450, and 850 keV ($T_{1/2}$ = 44 min) and 1680, 1320, and 800 keV ($T_{1/2}$ = 7.1 hours) were obtained for the isomeric states. The β−γ coincidences were investigated. The dependence of the fractional isomer yield on the energy of α particles bombarding the target was measured. This allows one to assign the half-life 7.1 hours to the state with the angular momentum $9/2^+$ and $T_{1/2}$ = 44 min to the state with $1/2^-$. The σ parameter that determines the width of the statistical distribution of the nuclear levels according to their angular momentum was determined to be 5.0 ± 0.8. (auth)

48569 SPECTROSCOPY OF THE ^{117}In NUCLEUS. Begzhanov, R. B.; Khodzhaev, M. Kh.; Sharipov, Sh. Sh. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz., 8: 247-54(Aug. 1968). (In Russian).

Experimental results are given on the measurement of lifetimes of excited states and γ−γ angular correlations for the cascades 1306−274 and 690−345 keV in the ^{117}In nucleus. The lifetimes $T_{1/2}$ of the levels 588, 658, 747, and 1890 keV were found to be: $0.20 \pm 0.05 \times 10^{-9}$, $55.0 \pm 2.0 \times 10^{-9}$, $4.82 \pm 0.1 \times 10^{-9}$, and $0.42 \pm 0.06 \times 10^{-9}$ sec, respectively. The following quantum numbers are ascribed to the levels at 747, 658, and 312 keV and to the transitions among them: $3/2^+$(E2,M1), $3/2^+$(E1,M2), $1/2^-$ and for the levels at 1890, 588, and 312 keV: $3/2^+$(E1,M2); $3/2^-$(E2,M1); $1/2^-$. The experimental results are compared with the values of spins, energies, and transition probabilities for all the odd indium isotopes, as calculated in the framework of the Davydov model. (auth)

48570 ISOTOPE MASSES AND THE BINDING ENERGY OF NUCLEI IN THE REGION FROM Cs UP TO Eu. Demirkhanov, R. A.; Dorokhov, V. V.; Dzkuya, M. I. Yadern. Fiz., 8: 255-64(Aug. 1968). (In Russian).

The masses of all the stable isotopes of Cs, Ba, La, Ce, Pr, Nd, Sm, and Eu were measured using the mass-spectroscopic method. The masses of all the elements were measured with the "internal" agreement test and using the method of closed cycles. In all, 136 various doublets were determined, and with their help the masses of 31 stable isotopes were calculated. In a number of cases, the accuracy of measurements of nuclear masses is increased by 3 to 10 times as compared with the data available. Relative error of the measurements is $\Delta M/M = 2$ to 5×10^{-7}. (auth)

Nuclear Theory

Refer also to abstracts 48202, 48203, 48264, 48418, 48443, 48444, 48448, 48449, 48455–48458, 48466, 48467, 48475, 48490, 48493, 48501, 48503, 48512, 48515–48517, 48520, 48524, 48532, and 48563.

48571 (CEA-R-3427) INSTABILITIES IN NUMERICAL SOLUTIONS TO FREDHOLM AND VOLTERRA INTEGRAL EQUATIONS OF THE FIRST KIND: RESOLUTION BY TCHEBYCHEFF POLYNOMIALS: APPLICATION TO PHOTONUCLEAR CROSS SECTIONS. Moriceau, Yves (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Mar. 1968. 45p. (In French). Dep.

A new method of solving the integral equations which describe photonuclear cross sections is explained. Smooth resolution is obtained by expanding functions built on equidistant interval experimental data in Tchebycheff polynomials. (J.W.R.)

48572 (IAE–1447) SINGLE-PARTICLE PROTON STATES OF RARE-EARTH NUCLEI. NEUTRON AND PROTON E1 TRANSITIONS. Chepurnov, V. A. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1967. 24p. (In Russian). Dep.

Single-particle proton states in the Woods−Saxon potential at 150 < A < 190 are examined by numerical integration of the boundary-value problem. A comparison is made of the structure of the states and the radial dependence of the amplitudes with the results obtained by methods of diagonalization. Single-particle neutron and proton E1 transitions are examined. (J PRS)

48573 (JAERI–1158, pp 1-9) NEW ISOMERISM AS A PROBE TO STUDY NUCLEAR STRUCTURE. Yamazaki, Toshimitsu (Tokyo Univ.). (In Japanese).

A new experimental method for studying isomerism and nuclear moments is described. Isomerism allowed by the generalized Nordheim rule is discussed. (auth)

48574 (JAERI–1158, pp 26-30) ALLOWED BETA TRANSITIONS WITH ANOMALOUSLY LARGE LOG-FT VALUES. Miyano, Kazumasa (Tokyo Univ.). (In Japanese).

During the past few years marked success has been made in the qualitative and quantitative explanations for the log-ft values of the allowed beta transitions in heavier nuclei by introducing the simple pairing model for either spherical nuclei or deformed nuclei. Variations from nucleus to nucleus were well reproduced in the log-ft values of the beta transitions although the calculated values had to be normalized in order to make them fit with experimental values, since the calculated absolute values were too small unless some normalization was done. Although such success has been brought about by conventional pairing models, anomalously large log-ft values beyond the ability of the pairing theories have sometimes been found in the allowed beta decays. One of the most striking examples of such anomalous transition is the case of ^{14}C. The observed half-life is about 10^5 times longer than expected. Such a long half-life can only be accounted for by accidental cancellation. Some irregularly large log-ft values have also been found in the spherical nuclei: around calcium isotopes ($1f_{\frac{7}{2}}$) and in ^{85}Kr and ^{87m}Y ($1g_{\frac{9}{2}}$). These cases are discussed qualitatively. (auth)

48575 (JAERI–1158, pp 64-7) NUCLEAR STRUCTURE IN THE INTERMEDIATE MASS REGION BY USING ISOBARIC ANALOGUE RESONANCES. Lee, S. M. (Tohoku Univ.). (In Japanese).

The characteristics of isobaric analogue resonance excitation for the study of nuclear structure are briefly reviewed. The possibility of finding pure collective states in the compound system as isobaric analogue resonances is discussed for the case of even-odd target nuclei. (auth)

48576 (JAERI–1158, pp 71-83) VIBRATIONAL STATES OF NUCLEI. Sano, Mitsuo (Osaka Univ.). (In Japanese).

Problems in the collective vibration of even-even nuclei are discussed. First, a brief summary is given of the various theories of collective oscillation based on the phenomenological models and on the microscopic description in the random phase approximation. Second, the possibility of existence of new nuclear vibrational states is discussed within the random phase approximation. Deviations from the random phase approximation are also considered in the framework of the microscopic theory of the collective excitations of spherical even nuclei. Phonon-phonon, phonon-quasiparticle, and quasiparticle-quasiparticle interactions are obtained by taking into account the difference of a quasiparticle pair operator from a pure boson; they are able to reproduce all of the observed orderings of the triplet $(0^+, 2^+, 4^+)$ in the excited states. Formulas are also given for the electromagnetic transition matrix elements of the nuclear states. Most of the numerical calculations, which were based on the conventional pairing plus quadrupole force, were made for ^{114}Cd. Finally the shape parameters β and γ are introduced, and collective vibrations of γ-unstable nuclei are discussed. (auth)

48577 (JAERI-1158, pp 84-9) A POSSIBLE DESCRIPTION OF "ROTATION-LIKE EXCITATIONS" IN Te, Xe, AND Ba ISOTOPES. Miyanishi, Yoshinao (Kyoto Univ.). (In Japanese).

A possible description of rotation-like excitations in spherical nuclei is proposed as an extension of the random phase approximation (RPA). This is done by adopting some new amplitudes in addition to those considered in the conventional RPA. The physical meaning of these new amplitudes is discussed. The equation of motion leads formally to the eigenvalue equation like that of RPA, but it is essentially nonlinear and should be solved self-consistently. Numerical results show that the energy spectra are smoothly shifted from the vibrational type to the rotational form, as the strength of the quadrupole force increases. The deformation of each excited state is discussed in detail. The single j shell model with the pairing plus quadrupole force was used for the sake of simplicity, although the essential point of the theory is unchanged in the more realistic case. (auth)

48578 (JAERI-1158, pp 96-8) COMMENTS ON THE OCTUPOLE MODE. Kusuno, Sadao (Osaka Univ.). (In Japanese).

A review and several comments on the octupole vibrations, rotations, and deformations are presented. (auth)

48579 (JAERI-1158, pp 99-105) MOLECULAR ASPECT IN ATOMIC NUCLEI. Ikeda, Kiyomi (Tokyo Univ.). (In Japanese).

The existence of states with molecule-like structures forces one to introduce the molecular aspect in studies of nuclear structure. The molecular viewpoint in atomic nuclei is developed. First, the quasi-molecular aspect in the Bohr model is summarized. A plausible nuclear shape is considered by taking the examples of the light 4n nuclei and nuclei in the actinide region. The rotational band structures in the case of a general axially symmetric shape are discussed. The anisotropic shape obtained by mixing the even and odd spherical harmonics is interesting, where the $K = 0^+$ and $K = 0^-$ band can be treated as a twin of same shape. This character is understood as a doublet inversion in the terminology of molecule. It is pointed out that the inversion doublet is observed in the nuclei of $^{16}O^*$ ($^{12}C - \alpha$) and ^{20}Ne ($^{16}O - \alpha$). (auth)

48580 (JAERI-1158, pp 106-12) $K = 0^+$ EXCITED LEVELS IN DEFORMED NUCLEI. Mikoshiba, Osamu (Tokyo Univ. of Education). (In Japanese).

Characteristic features of the excitation spectra of $K = 0^+$ intrinsic states are discussed for even deformed nuclei in the rare-earth region within the framework of the random phase approximation, using the pairing-plus-quadrupole, force model. The distributions in collectiveness of both pairing and quadrupole β vibrations of the lowest ten $K = 0^+$ states are numerically analyzed. The β-vibrational character is more dominant in the spectra of nuclei in the beginning of the deformed region, whereas the pairing modes are relatively more important in the middle of the deformed region. (auth)

48581 (JAERI-1158, pp 113-14) EQUILIBRIUM DEFORMATION OF NUCLEUS. Wakai, Masamichi (Japan Atomic Energy Research Inst., Tokai). (In Japanese).

The centrifugal stretching effect is investigated considering the Coriolis anti-pairing effect. The numerical calculation shows that the effect has no severe influence on the rotational spectra of low spins. (auth)

48582 (JAERI-1158, pp 115-17) COMMENTS ON THE PROBLEMS OF SENIORITY MIXING AND γ-BAND STRUCTURES. Nomura, Masao (Tokyo Univ.). (In Japanese).

The wave functions of nuclei in the region near $A = 90$ were investigated with the method of shell-model calculation. A comparison of seniority in the weak coupling model and in the strong coupling model is made. The properties of the wave functions of nuclei in the midshell is discussed. A comment is also given on the structure of γ-vibrational bands in deformed nuclei. (auth)

48583 (JAERI-1158, pp 118-19) LIFETIME OF A "SHAPE ISOMER." Ohnishi, Naoki (Tokyo Inst. of Tech.). (In Japanese).

The lifetime of a shape isomer, which has oblate deformation, is calculated. The B(E2) transition probability from the band head on the oblate band to the 2^+ state of the prolate band is estimated. It depends sensitively on the overlapping integral between the oblate state and the prolate state. The overlapping integrals between the states with various deformations for the nuclei with $Z = 62$ and $N = 90$ are tabulated. (auth)

48584 (JAERI-1158, pp 120-2) NOTE ON THE Y_{40} DEFORMATION IN HEAVY NUCLEI. Harada, Kichinosuke (Japan Atomic Energy Research Inst., Tokai). (In Japanese).

The possible existence of Y_{40}-deformation in heavy nuclei has been suggested by many alpha decay analyses. A brief review on this topic is made. The effects of the perturbing potential of the Y_{40} type on the Nilsson levels are discussed qualitatively. (auth)

48585 (JAERI-1158, pp 125-32) REVIEWS ON THE NUCLEAR MODELS IN THE REGION OF THE fp SHELL. Ichimura, Munetake (Nihon Univ., Tokyo). (In Japanese).

The structure of nuclei in the $20 \leq Z \leq 40$, $20 \leq N \leq 50$ region is surveyed. The region is divided into four regions: $f_{\frac{7}{2}}$-shell; multi j single closed shell region (Ni isotopes and $N = 50$ isotopes); $Z < 28 < N$ region; and BCS + RPA region. The first three regions are considered to be mainly in the shell-model region; and the main interest in the first two regions is seniority, while that for the third region is n-p interaction. Some analyses for these regions are reviewed. Several types of seniority schemes, e.g., generalized seniority, odd group model, seniority-reduced isospin, etc, are interpreted. (auth)

48586 (JAERI-1158, pp 133-7) EFFECTIVE PROTON-NEUTRON INTERACTION IN pf SHELLS. Ogawa, Kengo (Tokyo Inst. of Tech.). (In Japanese).

Effective interactions between $1f_{\frac{7}{2}}$ protons and $(2p_{\frac{3}{2}} \cdot 1f_{\frac{7}{2}} \cdot 2p_{\frac{1}{2}})$ neutrons are determined for forty levels of the nuclei with $N = 29$. The energy levels are reproduced very accurately. The twenty matrix elements obtained are fitted with a two-body potential of a general type, and the resulting values for the eight potential strengths showed that the role of the tensor force is very important for the changing of the $2p_{\frac{3}{2}} - 2p_{\frac{1}{2}}$ splitting between ^{49}Ca and ^{57}Ni. The energy levels of ^{58}Mn, which has an anomalous ground state spin, are calculated by using these matrix elements; and fairly good agreement with experimental data is obtained for all low-lying levels. (auth)

48587 (JAERI-1158, pp 138-44) EFFECTIVE NEUTRON-PROTON INTERACTION IN ODD-ODD NUCLEI. Sasaki, Kiyoshi (Nihon Univ., Tokyo); Tonozuka, Isao (In Japanese).

The available results on the effective neutron-proton interaction in odd-odd nuclei were reviewed. Also, the properties of this interaction were investigated for the low-lying energy levels of ^{90}Y and ^{92}Nb on the basis of the j-j coupling shell model. Assuming a finite-range central force, the energy spectra of these nuclei were calculated; and the parameters of the interaction were determined by the method of the least square fit. Furthermore, the effects of the tensor force on the central force were studied. It is shown that the results are not significantly different from those obtained with only the central force. (auth)

48588 (N-68-24661) INELASTIC SCATTERING FORM FACTORS USING PROJECTED HARTREE-FOCK WAVE FUNCTIONS. Braley, Richard C.; Ford, William F. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1968. 28p. (NASA-TN-D-4566). CFSTI.

The theory of inelastic scattering is formulated, using detailed nuclear wave functions which are obtained from nuclear structure calculations. The inelastic scattering is assumed to proceed through a direct reaction, and nuclear states are obtained by projecting states of good (J^π, J_z) from a variational Hartree-Fock wave function. General expressions for transition amplitudes and the nuclear form factors are derived, and the form factors for inelastic proton scattering are presented. These form factors are compared with those based on the shell model and macroscopic collective model. It is concluded that the restrictions imposed in the Hartree-Fock model must be relaxed if the model is to give the correct order of magnitude for reaction cross sections. (auth) (STAR)

48589 (SRARI-P-3) ANGULAR MEASUREMENTS OF FRAGMENTS OF FISSION IN AN IONIZATION CHAMBER. Basova, B. G.; Ivanov, O. I.; Kushnir, Yu. A.; Shimanokii, A. M. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1967. 12p. (In Russian). Dep.

An angular fission fragment measurement method is developed, which allows the utilization of an ionization chamber for multiparameter measurements with simultaneous recording of energy and angular fission fragments distributions. Angular resolution is characterized by $(\cos\theta^- \cos\theta)^2$ equal to 0.03 at $\theta = 90°$ and 0.06 at $\theta = 0°$. The electronic circuit fast response is characterized by a 20 μ sec dead time. (auth)

48590 INTRODUCTION TO NUCLEAR THEORY. McCarthy, I. E. New York, John Wiley and Sons, Inc., 1968. 569p.

The techniques that are used for understanding the simpler nuclei and reactions are presented. The understanding and calculation of the motion and correlations of nucleons in large aggregates and the discovery of the various modes of motion by means of reaction experiments are emphasized. (D.C.W.)

48591 BEHAVIOUR OF DWBA STRIPPING AMPLITUDES NEAR THE BUTLER POLE. Andrews, M.; Bertram, W. K.;

Tassie, L. J. (Australian National Univ., Canberra). Aust. J. Phys., 21: 423-9(Aug. 1968).

Using integral representations of the bound-state wave functions it is shown that, near the so-called Butler pole, DWBA amplitudes of (d,p) and certain (d,n) reactions depend only on the asymptotic parts of these wave functions. Furthermore, the zero-range approximation for the n-p interaction in the deuteron is exact at the pole. Also, it is found that for (d,n) stripping to loosely bound levels of heavy nuclei, the Butler pole disappears in the sense that the amplitude is no longer infinite there. (auth)

48592 ENERGY LEVELS OF SEMIMAGICAL NUCLEI. Baier, J. (Oesterrische Studiengesellschaft fuer Atomenergie, Seibersdorf); Kriechbaum, M. Z. Naturforsch., 23a: 468-70(Mar. 1968). (In German).

A simplified model for the calculation of the structure of even Pb, Sn, and Ni isotopes (with $200 \leqq A \leqq 206$; $A = 210$; $112 \leqq A \leqq 124$; and $58 \leqq A \leqq 64$) is described. No significant derivations from earlier theoretical results were obtained with the simplified model. The lowest 2^+ state of the isotopes studied agrees well with experimental data. (J.S.R.)

48593 ON EIGHT-DIMENSIONAL QUASISPIN. Pang, Sing-chin. Ann Arbor, Mich., Univ. of Michigan, 1967. 212p. Thesis.

The exact solution of the pairing problem in the Ω(spatial) – ST scheme is formulated in terms of the matrix elements of the pair creation and annihilation operators coupled to zero spatial angular momentum quantum number. This makes it possible to study the pairing interaction with different strengths for the $S = 0$ ($T = 1$) and $S = 1$ ($T = 0$) pairs, as well as for mixed configurations of several single-particle levels. The mathematical formulation of the problem involved the study of an orthogonal group in eight dimensions, the so-called quasispin group. The representations are broken down according to $O(8) \supset O(6) \sim SU(4) \supset SU(2) \times SU(2)$, where SU(4) is the usual Wigner supermultiplet. In addition, the basis is chosen such that the number operator of the system is diagonal. By using the Wigner–Eckart theorem, the matrix elements of the pair operators are split into segments of reduced matrix elements. They are those connecting O(8) with SU(4) and those connecting SU(4) with the SU(2)-spin space and SU(2)-isospin space groups. The Wigner coefficients involved in these segments are calculated and tabulated for the representations needed for seniority $v = 0$ and $v = 1$. In order to do this, the state functions built from O(8) to O(6) and SU(4) to $SU(2) \times SU(2)$ are studied. With this general formulation a sample calculation was carried out for the case of a pairing interaction of variable strength connecting two single-particle levels similar to those of the s-d shell. The calculation is done for nucleon numbers of 4, 6, 8, and 10 and states with seniority $v = 0$. The results show that the pairing interaction is very effective compared with the particle energy and wins out in the competition with the single-particle excitations for all but the weakest pairing strengths and that the pairing interaction tends to make more stable those states built from the largest possible number of α-like groupings of four particles. (Disser. Abstr.)

48594 DISTRIBUTION OF CHARGE AND MATTER WITHIN NUCLEI. Nemeth, Judith (Lorant Eotvos Univ., Hungary). Fiz. Szemle, 18: 235-7(1968). (In Hungarian).

The dimensions of nuclei may be determined on the basis of the determination of either the charge or the material, requiring a measurement of either of the electric field of the protons or of the field of force of the nucleons, respectively. The methods used for charge distribution measurements include electron-scattering techniques and the measurement of the radiative transitions of μ^- atoms; the π scattering method is applied to determine the distribution of matter. Study of the radiative behavior of the μ^- atoms revealed that the scattering cross section exhibits deviations even for very light nuclei. In nuclei such as Ca, the charge-density distribution is not monotonous but possesses a weak oscillation; this is probably due to the shell structure. High-energy proton scattering experiments indicated that distribution of matter is similar to the distribution of charge, although evaluation of the experiments is more difficult. The large number of α particles or deuterons emitted during direct reactions seems to indicate that the nucleons form light nuclei on the surface of heavy nuclei. (TTT)

48595 INTERMEDIATE STRUCTURE IN NUCLEAR REACTIONS. Kennedy, Hugh P.; Schrils, Rudolph (eds.). Lexington, Ky., University of Kentucky Press, 1968. 227p. $7.50.

A series of lectures trace the development of nuclear reactor formalism encompassing several theories of nuclear structure. (J.W.R.)

48596 PARITY MIXING IN NUCLEAR SINGLE-PARTICLE ORBITALS AND DIRECT PHOTONUCLEAR REACTIONS. Boffi, S. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Nuovo Cim., 57B: 247-50(Sept. 11, 1968).

Single-particle wave functions with undefined parity are used to investigate direct photonuclear reactions on odd-A nuclei at low energies. (J.W.R.)

48597 SELF-CONSISTENT SYMMETRIES IN THE HARTREE–BOGOLYUBOV THEORY. Sauer, P. U. (Univ., Muenster, Ger.). Nuovo Cim., 57B: 62-76(Sept. 11, 1968).

Ripka's theorem on self-consistent symmetries of the Hartree–Fock method is extended to apply also to the Hartree–Bogoliubov theory. The connection between symmetries of the intrinsic nuclear ground state and restrictions of the Hartree–Bogoliubov transformation is investigated. The restricted quasi-particle transformation used in previous work, especially its reality, is discussed. (auth)

48598 EXPERIMENTAL STUDY OF THE IMPORTANCE OF THE COULOMB CORRECTION IN THE PHENOMENON OF PAIR PRODUCTION BY PHOTONS AT 2 TO 20 MeV. Roche, G.; Avan, L.; Isabelle, D. (Univ., Clermont-Ferrand, France). Nuovo Cim., 57B: 125-34(Sept. 11, 1968). (In French).

The spectrometer used to measure pair production is described. Results are presented for two series of experiments: first with 2.62 MeV monoenergetic γ-rays and three different targets (aluminium, silver and gold), second with a hardened bremsstrahlung spectrum of 13 MeV maximum energy and two targets only (aluminium and gold). Experimental results are compared with theoretical calculations presented in a previous article. A good agreement is found for $Z = 47$, and a fair one for $Z = 79$. For a heavy element the agreement becomes worst when the photon energy is decreased or when the energetic divergence between the two electrons is increased. (auth)

48599 CHARGE DISTRIBUTION OF ^{4}He. Jain, S. C. (Allahabad Univ., India). Nuovo Cim., 57B: 135-8(Sept. 11, 1968).

The charge distributions of the ^{4}He nucleus are calculated by using a modified Irving wave function, whose parameters are obtained from a variational calculation of the binding energy of ^{4}He, using a central velocity-dependent potential. Results are in reasonable agreement with similar calculations of Tang and Herndon using hard-core potentials and the experiments of Frosch et al. (auth)

48600 BINDING-ENERGY SHIFT AND RECOIL CORRECTIONS IN TUNNELLING REACTIONS. Taffara, L. (Univ., Lecce, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy); Vanzani, V. Nuovo Cim., 57B: 229-34(Sept. 11, 1968).

The Feynman-diagram approach to heavy-ion direct interactions is extended to transfer processes between two light nuclei or light incident particles and heavy nuclei. Corrections arising from binding-energy differences between initial and final states and from recoil terms are evaluated. (J.W.R.)

48601 CALCULATION OF THE COULOMB CORRECTION IN THE PHENOMENON OR PAIR PRODUCTION BY γ RAYS OF ENERGY BETWEEN 2 AND 20 MeV. Roche, G.; Isabelle, D.; Avan, L. (Univ., Clermont-Ferrand, France). Nuovo Cim., 57B: 114-24(Sept. 11, 1968). (In French).

An extension of the Bethe and Maximon calculation for pair production by photons of intermediate energies (2 to 20 MeV) is presented. Included in the matrix element are the main terms omitted previously. It is shown that the correction term introduced can be of the same order of magnitude than the leading one, especially for pair production by low-energy photons (~2 MeV) in the field of heavy elements. The results are valid for all values of the pair opening angle, but the screening is assumed to be negligible. (auth)

48602 STUDY OF NEUTRON CLOSED-SHELL NUCLEI. Lombard, R. J. (Univ. of California, San Diego, La Jolla). Nucl. Phys., A117: 365-75(1968).

Neutron closed-shell nuclei have been studied in the framework of the BCS approximation. The residual interaction is of Gaussian type with a Serber mixture. The calculation is limited to the diagonalization in the two-quasiparticle subspace. The closed-shell particles are considered as inert. Low-energy spectra, E0 transitions, and magnetic moments are discussed. The results are in qualitative agreement with experiment. (auth)

48603 COLLECTIVE BEHAVIOUR IN SOME $1f_{\frac{7}{2}}$ EVEN-EVEN NUCLEI. Mukherjee, S. N. (Univ. of Connecticut, Storrs); Shastry, S.; Rustgi, M. L. Nuovo Cim., 57B: 25-9(Sept. 11, 1968).

Low-lying excited states of some of the $1f_{\frac{7}{2}}$ even-even nuclei were calculated employing the simple asymmetric rotor-vibrator

model. The results obtained are in agreement with experiments and another fairly complicated calculation. The collective behaviour indicated here should encourage more experiments specially on transition probability. (auth)

48604 PARITY MIXING IN NUCLEAR HARTREE–FOCK ORBITALS AND ELASTIC AND QUASI-FREE ELECTRON SCATTERING FROM NUCLEI. Boffi, S. (International Atomic Energy Agency, Trieste, Italy. Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy); Pacati, F. D.; Sawicki, J. Nuovo Cim., 57B: 103-13(Sept. 11, 1968).

Parity-projected nuclear wave functions made of Hartree–Fock single-particle orbitals with undefined parity are applied to the study of the reactions $^{12}C(e,e'p)$ and electron elastic scattering from ^{12}C. It is found that the angular and energy distributions for the quasi-free electron scattering and the electron elastic scattering form factor are insensitive to the mixing of parities in the Hartree–Fock orbitals, at least for high incoming electron energies. (auth)

48605 DIFFERENTIAL FORMS AND NUCLEAR STRUCTURE. Ramanna, R. (Bhabha Atomic Research Centre, Trombay, India). Proc. Indian Acad. Sci., Sect. A, 67: 328-49(June 1968).

The solution of a set of Schroedinger's equation can be considered from the point of view of integration of differential forms over simplices in higher dimensional differentiable manifolds. In this way, the problems of nuclear structure are transferred from conjecturing potential wells and nuclear models to one of integration using the appropriate simplices. Using this approach, it is shown that without any reference to physical models it is possible to obtain the neutron-proton ratio of stable spinless nuclei and their Coulomb and binding energies, which is in good agreement with that obtained by experiment. It is also shown from the nature of the solution that a nucleus consists of only two types of particles, one having an energy of the Coulomb type and the other neutral. Possible extension to the theory for nuclear systems having spin is also discussed. (auth)

48606 NEUTRON AND PROTON DISTRIBUTION IN NUCLEI. Speth, J. (Technische Hochschule, Munich). Z. Phys., 214: 457-63(1968).

The energy gap for deformed nuclei is calculated using the gap equation which appears in the Migdal theory of finite Fermi systems with pair correlations. To obtain good agreement with experiment for nuclei with neutron excess, it is necessary to choose differently the forms of the density dependent residual interaction for the protons and neutrons because of the difference between their density distributions. The distributions obtained are in good agreement with experiment as well as with other theoretical predictions. It is also shown which approximations are required to reduce the general gap equation to the special Migdal equation. (auth)

48607 AN ESTIMATE OF THE ^{3}He SPIN–ORBIT POTENTIAL FROM SPIN-FLIP MEASUREMENTS. Patterson, D. M.; Cramer, J. G. (Univ. of Washington, Seattle). Phys. Lett., 27B: 373-5 (Aug. 19, 1968).

The spin-orbit potential depth of ^{3}He particles has been obtained by comparing back angle spin-flip measurements of the $^{12}C(^3He)^{12}C^*(4.44)$ inelastic scattering reaction with DWBA calculations, and is found to be 2.7 ± 0.7 MeV. This result is found to be relatively insensitive to the details of the spin-independent part of the optical model potential. (auth)

48608 ON INTERFERENCE EFFECTS IN RESONANCE SCATTERING BY CRYSTALS OF γ RAYS FROM NUCLEI HAVING TWO MOESSBAUER TRANSITIONS. Belyakov, V. A.; Aivazyan, Yu. M. (All-Union Scientific Inst. of Physical-Technical and Radio-Technical Measurements, Moscow). Phys. Lett., 27B: 352-3(Aug. 19, 1968).

The γ-process in which crystal lattice effects on angular distribution and radiation width of the final transition in the γ-cascade are examined. The possibilities of experimental observation of the phenomenon are discussed. (auth)

48609 STRUCTURE OF INTERMEDIATE COUPLING STATES IN THE NUCLEAR SHELL MODEL. Harvey, M.; Sebe, T. (Chalk River Nuclear Labs., Ont.). Nucl. Phys., A117: 289-308 (1968).

A simple extension to the concept of submodels of the nuclear shell model is examined with basis states defined in terms of the nonorthogonal states from several submodels. It is shown that in some cases a simpler description of states in intermediate coupling can be given with a nonorthogonal set of states than with an orthogonal set from a single submodel. The examples of ^{19}F and ^{37}Ar are considered to show how use can be made of nonorthogonal states in a realistic calculation. (auth)

48610 HIGH-ENERGY SCATTERING OF STRONGLY INTERACTING COMPOSITE PARTICLES. Czyz, W. (American Univ., Washington, D. C.); Mazimon, L. C. Phys. Lett., 27B: 354-7 (Aug. 19, 1968).

High energy electron-nucleus, nucleon-nucleus and nucleus-nucleus scattering is analyzed in the framework of geometrical optics. It is shown that good agreement with experimental cross sections is obtained provided that a correction for the center of mass motion is included. (auth)

48611 SUDDEN APPROXIMATION AS APPLIED TO DEUTERON STRIPPING AT LOW ENERGIES. Baker, T. F.; Buttle, P. J. A.; Goldfarb, L. J. B. (Univ. of Manchester, Eng.). Phys. Lett., 27B: 348-51(Aug. 19, 1968).

A recent formulation of deuteron stripping by Butler et al. is applied to the sub-Coulomb region. There is predicted strong peaking in the forward hemisphere and great increases in yield as the energy is lowered, in striking contrast with experiment. (auth)

48612 BETA EMISSION AND THE BACH. Lewis, D. T. (Lab. of Government Chemist, London). Chem. Ind. (London), No. 35, 1173-6(Aug. 31, 1968).

The "bach-tamaid" theory for the structure of subnuclear particles (Nature, 216: 573, 784(1967); Chem. Ind., 23: 729 and 34: 1146(1968)) is extended to a consideration of beta emission. (UK)

48613 NEW METHOD TO LIMIT ABUNDANCE OF COSMIC RAY QUARKS. Libby, L. M.; Thomas, F. J. (Univ. of Colorado, Boulder. · RAND Corp., Santa Monica, Calif.). Nature (London), 219: 711-12(Aug. 17, 1968).

Previous estimates concerning upper limits to the cosmic-ray flux of quarks are briefly reviewed, and it is stated that considerations of quark chemistry allow smaller limits to be set by quite different methods. Quark-induced fission is considered, and it is shown that quarks of charges $-1/3$ and $-2/3$ are able to catalyze fission of heavy elements, whether or not strong nuclear forces are important. An upper limit on the density of naturally occurring quarks is set by a new method, depending on the fact that pathological radioactivity of pure heavy metals in which quarks could catalyze fission has not been reported. (UK)

48614 NUCLEAR STRUCTURE STUDIES AT MEDIUM ENERGIES. Jackson, Daphne F. (Univ. of Surrey, London). Advan. Phys., 17: 481-508(July 1968).

Reactions initiated by electrons, nucleons, pions, and kaons in the energy region 100 to 600 MeV are discussed. It is shown that valuable information on nuclear structure can be obtained from these reactions, although precise determination of the nucleon momentum distribution in nuclei requires a combined study of a range of reactions and elastic scattering. It is suggested that attempts to determine the nucleon pair correlation function may be premature. (auth)(UK)

48615 HELION AND TRITON OPTICAL POTENTIALS. Hodgson, P. E. (Oxford Univ.). Advan. Phys., 17: 563-604 (July 1968).

The representation of the interaction between three-nucleon systems and nuclei by an optical potential is discussed, and the results of all existing analyses are tabulated. (auth)

48616 THE HERMITIAN BRUECKNER MATRIX AS AN EFFECTIVE INTERACTION. von Gruenberg, H. (Univ., Cologne). Z. Phys., 215: 359-67(1968).

Canonical transformations are discussed which transform the nuclear two-body potential into the hermitian Brueckner matrix. Some of the properties of such transformations such as induced many-body forces and the influence of localized Bethe–Goldstone states are investigated. (auth)

48617 PARTICLE–HOLE AMPLITUDES IN SPHERICAL NUCLEI. Emrich, K.; Theis, W.; Werner, E. (Technische Universitaet, Hanover). Z. Phys., 215: 335-42(1968).

Equations and relations are discussed which allow calculation of particle-hole amplitudes of excited states of spherical nuclei. In particular the case where the Bethe–Salpeter equation must be solved in both particle-hole channels is investigated. (auth)

48618 SEMI-ANALYTICAL THEORY OF MUONIC X-RAY LEVELS. Bethe, H. A.; Negele, J. W. (Cornell Univ., Ithaca, N. Y.). Nucl. Phys., A117: 575-85(1968).

A perturbation calculation is made of the energy levels of muons in the field of a nucleus, starting from the case of a nucleus of uniform charge distribution. The effect of a change of the nuclear charge distribution $\rho(r)$ on the energy of the 1s and 2p states is expressed as a simple integral over $\rho(r)$. (auth)

48619 NEW FORMULA FOR ROTATIONAL ENERGIES. Holmberg, P.; Lipas, P. O. (Univ. of Helsinki). Nucl. Phys., A117: 552-60(1968).

The ground-state rotational bands of deformed even nuclei are described by the two-parameter formula $E = \alpha[\sqrt{1 + bJ(J+1)} - 1]$; expanded, it gives the form of the usual power series in $J(J+1)$. The formula is deduced from experimental level systematics; alternatively, it can be derived from nuclear hydrodynamics. With the two parameters determined from two medium-high levels, our formula describes rather well the other levels, whereas the usual power series tends to diverge for high J-values. Other recent descriptions of rotational spectra are appreciably more complicated. (auth)

48620 NUMBER-CONSERVING TREATMENT OF THE PAIRING INTERACTION. Dang, G. Do (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Rev. Lett., 21: 917-18(Sept. 23, 1968).

A method of solution by iteration is given in the number-conserving treatment of the pairing interaction. It is local in the sense that only nuclei with A, A−1, and A−2 nucleons are involved in the calculations. (auth)

48621 PENETRATION OF NUCLEAR POTENTIAL BARRIER FOR DIFFUSE WOODS–SAXON POTENTIAL OF STRONG INTERACTION. Denisov, F. P.; Terent'ev, A. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 56-64(July 1968). (In Russian).

An exact solution is obtained for the problem of the penetration through the nuclear potential barrier for neutral and charged particles in case of the diffuse Woods–Saxon potential for the strong interaction. In the diffuse region of the potential, the solution is obtained as a rapidly convergent series that makes the numerical calculations essentially simpler. (auth)

48622 MANY-PARTICLE SYSTEMS. VI. N-FERMION SYSTEMS: DERIVATION OF A LOWER-BOUND SHELL MODEL. Carr, R. J. M.; Post, H. R. (Univ. of London, Eng.). J. Phys., A (London), 1: 596-609(Sept. 1968).

The program of reducing N-particle problems to one-particle problems is extended to include the Pauli principle. To calculate the ground-state energy of a system of N fermions interacting by pair forces, a rigorous lower-bound shell model is derived. This shell model follows a building-up principle, and tends to improve with increasing number of particles as well as with increasing strength of interaction. For twenty particles antisymmetric in ordinary space interacting by square-well interaction of strength $V_0\alpha^2 = 200\hbar^2/2m$ the shell model differs by less than 8% from the calculated upper bound, and hence a fortiori from the exact energy. In order to test the quality of the approximation for various interactions, it was necessary to calculate upper bound. (auth) (UK)

48623 COLLISION AND DECAY PHENOMENA. Gottfried, K. (Cornell Univ., Ithaca, N. Y.). pp 1-73 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

A unifying treatment of various scattering problems, such as electron scattering by an atom, or neutron scattering by a nucleus, is presented. The resonance scattering of a particle (or photon) by a bound system is considered, leading to a study of radiative decay. (D.C.W.)

48624 SELECTED TOPICS IN NUCLEAR REACTIONS. Margolis, B. (McGill Univ., Montreal). pp 311-42 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

Several approaches to resonance reactions and scattering are discussed. Use of the Eikonal approximation in nuclear reactions is considered in detail. (J.W.R.)

48625 MUON-CAPTURE IN NUCLEI AND MIGDAL THEORY. Rho, Mannque (CEN, Saclay, Gif-sur-Yvette, France). pp 343-437 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

The Conserved Vector Current Hypothesis and the Partially Conserved Axial–Vector Current Hypothesis, both from elementary particle weak interaction theory, are applied to systems of complex nuclei to explain the capture of muons by nuclei. The results agree well with experimental data. (J.W.R.)

48626 HIGH ENERGY SCATTERING FROM NUCLEI. Wilkin, C. (Brookhaven National Lab., Upton, N. Y.). pp 439-507 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

Attempts to understand the small angle elastic scattering of 1-GeV protons from deuterium, helium, carbon, and oxygen, and also the excitation of low-lying states are considered. A review of nuclear structure determinations from high-energy electron scattering is also given. (J.F.P.)

48627 NUCLEAR DEFORMATION IN THE SHELL MODEL. Kurath, D. (Argonne National Lab., Ill.). pp 199-272 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

An isospin formalism for the shell-model description of nuclear deformation in light nuclei is presented. The dependence of various observables on nuclear deformation is investigated, assuming deformed single-particle orbitals from Nilsson and Hartree–Fock calculations. In particular, electromagnetic properties and spectroscopic factors for single-nucleon transfer are studied. (D.C.W.)

48628 EFFECTIVE INTERACTIONS IN FINITE NUCLEI. Kahana, S. (McGill Univ., Montreal). pp 75-122 of Nuclear and Particle Physics. Margolis, B. (ed.). New York, W. A. Benjamin, Inc., 1968.

The use of realistic forces in the nuclear many-body problem is demonstrated in a shell model calculation using a second-quantized formalism. (J.W.R.)

48629 PRESENT STATE OF THE THEORY OF HEAVY ION–NUCLEUS REACTIONS. Grabowski, Janusz (Instytut Fizyki Jadrowej, Krakow). Postepy Fiz., 14: 257-70(1968). (In Polish).

Theoretical results obtained in recent years in the study of elastic scattering of complex nuclei at energies greater than the Coulomb barrier are described. The results are based on the optical model and the quasiclassical approximation of the relative motion of complex nuclei. (auth)

48630 THREE-PARTICLE REACTIONS AND PARTIAL WAVES. Sauerland, T. (Ruhr Univ., Bochum, Ger.). Z. Phys., 215: 242-55(1968). (In German).

A formal scattering theory for reactions with three outgoing particles is developed. The transition amplitude is written as an expansion of partial waves numbered by the generalized angular momentum λ in the six-dimensional space and by the ordinary angular momentum. For potentials of finite range, only a limited number of partial waves is important. The dependence of the cross section on the position of the decay plane is investigated as well as the distribution of the particle energies in the Dalitz plots. Symmetry with respect to permutations of identical particles is taken into account. (auth)

48631 REFLECTION SYMMETRY AND FISSION MASS RATIOS. Griffin, James J. (Univ. of Maryland, College Park). Phys. Rev. Lett., 21: 826-9(Sept. 16, 1968).

It is shown that the collective potential energy surfaces for rapid deformations leading to nuclear scission favor asymmetric mass division. A "walk-run" fission process is proposed, in which a slow deformation to the saddle-point shape is appropriately described by the liquid-drop model, and a rapid collective deformation then carries the nucleus from saddle point to scission. The most probable mass ratio decreases with decreasing Z^2/A, in qualitative agreement with empirical fact. (auth)

48632 OPTICAL ANISOTROPY OF ISOMERS IN THE REGION OF TRANSURANIC ELEMENTS. Baldin, A. M.; Semenko, S. F.; Tulupov, B. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 8: 326-30(Aug. 1968). (In Russian).

The properties of spontaneously fissile isomers are interpreted in terms of conceptions of molecular optics. An experimental check of the hypothesis on the form isomerism is proposed. (auth)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 47112, 47263, 47430, 47660, 47661, 47671, and 48792.

48633 (APDA-307) DESIGN, FABRICATION, AND PRELIMINARY OPERATION OF THE STEAM GENERATORS FOR THE ENRICO FERMI ATOMIC POWER PLANT. Anderson, R. H.; Ford, J. A.; Lindsey, P. S. (Atomic Power Development Associates, Inc., Detroit, Mich.). Aug. 1968. Contract AT(11-1)-865. 301p. Dep. CFSTI.

A chronological history is given of the steam generators at the Enrico Fermi Atomic Power Plant which consists of their design, fabrication, and preliminary operation through February 28, 1965. A description of the studies and experimental programs leading to the basic design concepts specified for these units is presented, including the specifications to which they were purchased. A description and evaluation of the proposals received is presented followed by a detailed description of the design chosen and a summary of the design analyses. The fabrication of the three steam generators and their shipment and installation in the Fermi plant is also described. The experience gained during the preoperational test and preliminary operation phases is presented. This includes a description of the stress corrosion cracking which was discovered in the tubes of the No. 2 steam generator during preoperational testing and the Na-water reaction which occurred in the No. 1 steam generator in 1962. The tests and studies to determine the causes of these events and the remedial action taken is also reviewed. The initial experience with leaking tube to tube-sheet joints and cracks in the ligaments of the water tube sheet is presented. The experience obtained with the Fermi steam generators, applicable to future steam generators, is summarized in the conclusions and recommendations section of this report. 15 references. (auth)

48634 (BAW-3867-4) FAST BREEDER REACTOR STATIC PHYSICS METHODS DEVELOPMENT AND ANALYSIS PROJECT. Quarterly Technical Report, April-June 1968. Roy, D. H. (ed.) (Babcock and Wilcox Co., Lynchburg, Va. Power Generation Div.). Sept. 1968. Contract AT(30-1)-3867. 47p. Dep. CFSTI.

Accomplishments in the development and utilization of a design-oriented, one-dimensional criticality and depletion code applicable to the physics analysis of fast reactors are described. Successful executions of the ultrafine group option in MC^2 and 68-group fine version of MC^2 are analyzed. The unresolved resonance routine for REGA is presented. Debugging of the modified STRIP and RAIM routines is described. Capabilities and formulation of the REDEP are analyzed. The depletion and fuel management studies for the small core is presented. (D.C.C.)

48635 (BNWL-SA-2052) FUEL CYCLE COSTS FOR FAST BREEDER REACTORS. Burnham, J. B.; Deonigi, D. E.; Nunn, S. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 19, 1968. Contract AT(45-1)-1830. 32p. (CONF-680818-1). Dep. CFSTI.

From Topical Meeting on Fast Reactors and the Universities, Troy, N. Y.

A comparison of fuel cycle costs for light water-cooled reactors (LWR) and fast breeder reactors (FBR) is tabulated. Doubling times, specific power, and turnaround times for high and low gain breeders are calculated; results are shown. Effects of exposure on doubling time is shown for $1/12$ year, $1/2$ year, and 1 year turnaround times. Fuel cycle sensitivity to throughput, fabrication and reprocessing costs is determined. Effects of plutonium costs in a LWR-FBR economy are evaluated; predicted plutonium costs are tabulated for a mixed economy. (M.L.S.)

48636 (DOCKET-50286-4) INDIAN POINT NUCLEAR GENERATING, UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 1, Suppl. 1, Exhibit B-1. (Consolidated Edison Co. of New York, Inc., New York). Aug. 30, 1968. 553p. Dep. CFSTI.

Comparison of the Indian Point Power Reactor, Unit 3 design with the AEC General Design Criteria is made. Pressure vessel NDTT determinations are discussed; the quality assurance program for primary system components is summarized. Effects of control rod ejection and power distributions for the worst time in core life for the fuel rods are analyzed. The research and development programs are outlined; quality control procedures are detailed. Tornado design criteria are given. Functioning of the containment fan-cooler units is evaluated; the heat removal and iodine scavenging functions of the containment spray system are discussed. Detailed analyses of stress limits for reactor vessel internals, cooling system components, and engineered safety features are given. A hypothetical startup accident is discussed; primary system fission product inventory, assuming 1% failed fuel, is tabulated. A hypothetical steam line break accident is analyzed; reactivity transients and coolant pressures are shown as functions of time. A detailed analysis of a primary system pipe rupture is given. A complete evaluation of containment integrity is presented; containment pressure response under blowdown and energy sources and sinks is included. Because of the relatively high population density of the Indian Point site, off-site consequences of a design basis accident are evaluated. Emergency power supply systems are discussed. (M.L.S.)

48637 (DOCKET-50295-9) ZION STATION, UNITS 1 AND 2, COMMONWEALTH EDISON COMPANY. Safety Evaluation. (Division of Reactor Licensing (AEC), Washington, D. C.). Aug. 21, 1968. 93p. (DOCKET-50304-9). Dep. CFSTI.

The complete evaluation of the Zion Power Reactor, Units 1 and 2, performed by the AEC, Division of Reactor Licensing, is given. (M.L.S.)

48638 (DOCKET-50315-9) DONALD C. COOK NUCLEAR PLANT. [Preliminary Safety Analysis Report], Amendment 5. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Sept. 6, 1968. 562p. (DOCKET-50316-9). Dep. CFSTI.

An outline of emergency plans for the Donald C. Cook Power Reactor, Units 1 and 2, is given. The complete report on the foundation investigations is included; a complete test boring location plan is shown. Technical Specifications are listed for the ice condenser containment and related systems. Details of the part length control rod drive mechanisms are given. Reactor trip and engineered safeguards actuation circuits are listed; leak detection and isolation of the component cooling loop and essential service water system are considered. The Emergency Core Cooling Systems are discussed; containment spray actuation is described. The containment structure design is evaluated; stress loadings are given. Scaled load plots for the containment structure are included; containment vessel linear design is detailed. Procedures and techniques for analysis of liner anchorage design are given; sample calculations are included. Methods of detection of possible liner corrosion are discussed. Startup tests to be performed on the various systems are listed. (M.L.S.)

48639 (DOCKET-50315-10) DONALD C. COOK NUCLEAR PLANT. [Preliminary Safety Analysis Report], Amendment 6. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Sept. 23, 1968. 101p. (DOCKET-50316-10). Dep. CFSTI.

Emergency Core Cooling Systems and the containment system for the Donald C. Cook Power Reactor, Units 1 and 2, are discussed. Transient response of the compressed air in the upper containment is analyzed. The basic assumptions made in assessing containment capability are outlined. The sizing basis for the drain area and lower plenum of the ice condenser is discussed. The ice condenser design is described; operation and integrity are analysed. (M.L.S.)

48640 (DOCKET-50320-4) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 2. Preliminary Safety Analysis Report, Amendment 3, Suppl. 1. (Jersey Central Power and Light Co., Morristown, N. J.). Sept. 3, 1968. 24p. Dep. CFSTI.

Additional information on the probable maximum hurricane for the site for Oyster Creek Power Reactor Units 1 and 2, is given. The probable maximum hurricane parameters are evaluated. A wind setup section, probable maximum hurricane tide profile, and extreme low tide profile for Barnegat Bay are shown. (M.L.S.)

48641 (DOCKET-50320-5) OYSTER CREEK NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 2. (Jersey Central Power and Light Co., Morristown, N. J.). June 28, 1968. 442p. Dep. CFSTI.

Quality control procedures and construction and fabrication codes are outlined for the Oyster Creek Power Reactor, Unit 2. Containment vessel liner design specifications are listed. Proof testing of the reactor building is outlined. The program for selection, testing, and analysis of grouted tendons is detailed. The report on performance of post-tensioning tendons and recommend relaxation values for prestressing steel are included. (M.L.S.)

48642 (DOCKET-50324-4) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report,

Amendment 1, Suppl. 1. (Carolina Power and Light Co., Raleigh, N. C.). Sept. 3, 1968. 223p. (DOCKET-50325-4). Dep. CFSTI.

Influence of munitions explosions at the Sunny Point Army Terminal, about 4 miles from the Brunswick Power Reactor site, is evaluated. The probabilities of a munitions ship exploding in the shipping channel are analyzed; effects of such an explosion are evaluated. Resultant air blast and ground shock effects are detailed; effects of water waves are considered; effects of missiles resulting from the explosion are analyzed. Reports from all consultants are listed. (M.L.S.)

48643 (FRIGG-2) HYDRODYNAMIC AND HEAT TRANSFER MEASUREMENTS ON A FULL-SCALE SIMULATED 36-ROD MARVIKEN FUEL ELEMENT WITH UNIFORM HEAT FLUX DISTRIBUTION. Nylund, O.; Becker, K. M.; Eklund, R.; Gelius, O.; Haga, I.; Hernborg, G.; Rouhani, Z.; Akerhielm, F. (Aktiebolaget Atomenergi, Stockholm (Sweden)). [1967]. 114p. Dep.

A series of experiments was performed in the 8 MW FRIGG loop with a uniformly heated 36-rod cluster, simulating a fuel element for the Marviken boiling heavy water reactor. The cluster consisted of rods with 4.4 m heated length and 13.8 mm outer diameter. In addition an unheated center rod of 20 mm diameter was present. Prototype reactor spacers were used. The investigations include the single- and two-phase pressure drops, the axial and radial void distributions, burnout in natural and forced circulation, the natural circulation mass velocity, the stability limit, and the details about the system during transient conditions. The pressure was 50 bars. The results are compared to data obtained in previous 6-rod tests and to predictions with existing correlations and models. (auth)

48644 (GAMD-8619) IRRADIATION-INDUCED DIMENSIONAL CHANGE IN BORONATED GRAPHITE CONTROL ROD ABSORBERS FOR THE FORT ST. VRAIN HTGR. Stansfield, O. M. (Gulf General Atomic, Inc., San Diego, Calif.). June 19, 1968. Contract AT(04-3)-633. 21p. Dep. CFSTI.

Dimensional change in neutron-irradiated boronated graphite is probably due primarily to a complex interaction of effects from fast-neutron damage, thermal-neutron capture by ^{10}B, and swelling of B_4C particles. A model for ^{10}B burnup and dimensional change in a typical absorber compact is developed taking into account effects of a ^{10}B burnup gradient and interaction of resulting damage zones. Use of the model in conjunction with irradiation data made possible an estimate of dimensional change in a Fort St. Vrain absorber compact (40 wt % boron) for 6 years service at 50% and 100% duty factors. In both hot-molded and extruded compacts, expansion is more probable than contraction in any direction at 6 years of continuous exposure. For hot-molded compacts, expansion of 5.0% and 0.5% may occur in the axial and radial directions, respectively. With extrusions, 1.0% and 2.0% expansion can be expected in the axial and radial directions, respectively. At 50% duty factor, there will be less expansion in all cases, and perhaps some radial contraction for hot-molded compacts. (auth)

48645 (GEAP-5623) USE OF INSTRUMENTED FUEL ASSEMBLIES FOR THE CORE THERMAL-HYDRAULIC ANALYSIS. GARIGLIANO DEVELOPMENT PROGRAM. Oliva, D.; Duckart, A. C. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr. 1968. Contract AT(04-3)-189. 201p. (EURAEC-2059). Dep. CFSTI.

Work performed under United States-Euratom Joint Research and Development Program.

GARIGLIANO POWER REACTOR — fuel assemblies for, description of instrumentation for; fuel assemblies for, calibration procedures for and data from instrumented; fuel elements for, thermocouple and flowmeter testing for; ionization chambers for, sensitivity of in-core; fuel assemblies in, performance of in-core instrumented; cooling system for, measurement of voids and exit steam quality from; coolant flow rates in, comparison of measured and calculated values for; power level determinations for, use of coolant flow measurements for; neutron flux determinations in, use of moveable in-core probes for; thermal and hydraulic analyses for, tabular summary of; coolant leakage from, determination of

REACTOR FUEL ELEMENTS — instrumentation for Garigliano, description of; thermocouples for Garigliano, calibration of; flowmeters for Garigliano, pressure drop measurements using

FLOWMETERS — pressure drop across Garigliano Power Reactor fuel bundles using turbine, measurements of; design of Garigliano Power Reactor turbine

RADIATION DETECTORS, IONIZATION CHAMBER — sensitivity of Garigliano Power Reactor in-core; design of Garigliano Power Reactor moveable

THERMOCOUPLES — calibration data for Garigliano Power Reactor fuel element (M.L.S.)

48646 (HPR-102) HBWR QUARTERLY PROGRESS REPORT, APRIL-JUNE 1968. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Aug. 1968. 224p. Dep.

HALDEN BOILING REACTOR — operations during April to June 1968; power production of, analysis during April to June 1968; physics measurements during April to June 1968; core configuration of, fuel assemblies loading during April to June 1968

REACTOR FUEL ELEMENTS — failure detection by gas sampling monitoring in HBWR, description of; assemblies of Zircaloy 2-clad uranium oxide (UO_2) and plutonium oxide (PuO_2)-uranium oxide (UO_2), description of HBWR test; burnup performance of Zircaloy 2-clad uranium oxide (UO_2) and plutonium oxide (PuO_2)-uranium oxide (UO_2), analysis of HBWR

RADIATION MONITORING — fuel failure detection by HBWR gas sampling, description of

IODINE ISOTOPES I-131 — fission product activity in HBWR coolant loop, analysis of

REACTOR CONTROL SYSTEM — development program for HBWR digital computer, progress during April to June 1968

URANIUM OXIDES UO_2 — fuel elements of Zircaloy 2-clad, burnup performance of HBWR

PLUTONIUM OXIDES PuO_2 — PuO_2-UO_2, fuel elements of Zircaloy 2-clad, burnup performance of HBWR

URANIUM OXIDES UO_2 — PuO_2-UO_2, fuel elements of Zircaloy 2-clad, burnup performance of HBWR

ZIRCALOY-2 — cladding of HBWR uranium oxide (UO_2) and plutonium oxide (PuO_2)-uranium oxide (UO_2) fuel elements of, performance during burnup of (D.L.C.)

48647 (HW-78912) TECHNICAL CRITERIA AND BASES SUPPLEMENTAL REACTOR SAFETY CONTROL: IPD REACTORS. Nilson, R. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). [nd]. Contract AT(45-1)-1350. 19p. Dep. CFSTI.

A set of technical criteria for fundamental requirements for safety control systems is listed. Justification is given for each criteria; the control philosophy for the Hanford IPD reactors is outlined. (M.L.S.)

48648 (IDO-17271) SPERT PROJECT. Quarterly Technical Report, July-September 1967. Taxelius, T. G. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). July 1968. Contract AT(10-1)-205. 46p. Dep. CFSTI.

REACTORS, PRESSURIZED-WATER — excursions in, measurement and analysis of effects of cold-startup and hot-standby conditions short-period; power transients in, effects of step-reactivity insertions on

REACTOR SAFETY EXPERIMENTS — excursions in SPERT pressurized-water oxide core mockup, effects of cold-startup and hot-standby conditions on short-period; fuel rods for SPERT, design characteristics of F-type

REACTOR FUEL ELEMENTS — temperatures of oxide, effects of initial system temperature and reactor period on hot-spot; operating history of SPERT oxide-type; investigation of bambooed SPERT rod-type; fuel rod characteristics for SPERT F-type; performance testing of SPERT F-type; cladding for SPERT F-type, integrity of

REACTOR SAFETY — excursion simulation for pressurized-water, step-reactivity induced

REACTIVITY — effects on pressurized-water reactor peak power, analysis of reactor behavior during (M.L.S.)

48649 (NEB-SS-21) AN ECONOMIC ANALYSIS OF GENERATION PATTERNS OF FUTURE POWER SYSTEMS. Moore, Edwin A. (National Energy Board, Ottawa (Ontario)). June 1968. 50p. CAN $0.75.

Future power systems generation will be selected to fill specific roles - nuclear power as base generation, fossil plants as intermediate generation, pumped storage as peaking, and gas turbines as reserve to augment older fossil units. A graphical method of determining the relative amounts of these generation types is developed. Pumped storage will utilize off-peak nuclear capacity as a source of pumping energy. Low-fueling-cost heavy water nuclear units and pumped storage plants will be highly complementary. Under optimum conditions this combination might constitute the entire system capacity. (auth)

48650 (ORNL-4254) MOLTEN-SALT REACTOR PROGRAM. Semiannual Progress Report for Period Ending February 29, 1968. (Oak Ridge National Lab., Tenn.). Aug. 1968. Contract W-7405-eng-26. 282p. Dep. CFSTI.

Separate abstracts are included for all six sections of the report presented. (D.C.C.)

For abstracts of individual sections see: 47112, 47204, 47675, 48651, 48652, and 48736.

48651 (ORNL–4254, pp 1-49) MOLTEN-SALT REACTOR EXPERIMENT. (Oak Ridge National Lab., Tenn.).

MOLTEN SALT REACTOR EXPERIMENT—operations experience through Feb. 29, 1968; xenon-135, poisoning in, effect of fuel system pressure, temperature, and level on; reactivity at zero power, long-term variations in residual; access nozzle temperatures in, effect of outlet salt temperature and fuel pump pressure on; temperature of entering fuel salt and points on reactor vessel, power-dependent differences in; components in, thermal cycle history of; power production indication by uranium-236 buildup in; component performance in; fuel off-gas sampler installation and testing in; fuel sampler-enricher in, decontamination and repair of; gamma source mapping in, use of pinhole camera for; freeze flange for, thermal cycle tests on prototype; control systems performance in; instrumentation systems performance in; noise analysis in, equipment and procedures for; control rod servo system performance under simulated uranium-233 loading conditions; excursion incidents with uranium-233 fuel loading in; analysis of hypothetical; reactivity balance variations with uranium-233 fuel loading in, analysis of anomalous long-term

URANIUM-236—buildup in MSRE, use for integrated power production indication of

BEARINGS—failures in MSRE main blowers

GAMMA CAMERAS—testing of pinhole, for source mapping in MSRE vessel

FLANGES—thermal cycle testing of MSRE prototype freeze

REACTOR SAFETY—excursion incidents in MSRE with uranium-233 fuel loading, analysis of hypothetical (H.D.R.)

48652 (ORNL–4254, pp 50-87) MSBR DESIGN AND DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

MOLTEN SALT BREEDER REACTOR—flow diagram for 2000 MW(e); components of 2000 MW(e), design parameters for; fuel drain tank for 2000 MW(e), design parameters for; physics measurements for 2000 MW(e), calculation of optimum; xenon-135 poisoning in 2000 MW(e), effects of control graphite on; maintenance program for 2000 MW(e), analysis of remote; control systems of 2000 MW(e), calculation of response for

HEAT TRANSFER SYSTEMS, REACTOR CONTAINMENT STRUCTURES, PRESSURE VESSELS—configuration of 2000 MW(e) Molten Salt Breeder Reactor, design parameters for

REACTIVITY—coefficients for 2000 MW(e) Molten Salt Breeder Reactor, calculation of optimum

XENON ISOTOPES Xe-135—poisoning in 2000 MW(e) Molten Salt Breeder Reactor of, effects of coated graphite on

PUMPS—configuration of 2000 MW(e) Molten Salt Breeder Reactor fuel salt, design parameters for optimum

BEARINGS—testing of 2000 MW(e) Molten Salt Breeder Reactor fuel salt pump, analysis of

REACTOR CONTROL SYSTEMS—response calculations for 2000 MW(e) Molten Salt Breeder Reactor, analysis of (D.C.C.)

48653 (ORNL-NSIC-50) COMPILATION OF NATIONAL AND INTERNATIONAL NUCLEAR STANDARDS (EXCLUDING U.S. ACTIVITIES). 4th Edition, 1968. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 75p. Dep. CFSTI.

All known national and international nuclear standards activities are tabulated. Standards activities of all national organizations, technical societies and government agencies are listed alphabetically by country. Standards activities are included for: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hungary, India, Israel, Italy, Japan, Netherlands, Norway, Pakistan, Republic of South Africa, Sweden, United Kingdom, and Yugoslavia. International organizations activities include: Bureau Veritas, European Organization for Nuclear Research, European Atomic Energy Community, International Air Transport Association, IAEA, International Commission on Radiological Protection, International Commission on Radiation Units and Measurements, International Electrotechnical Commission, Intergovernmental Maritime Consultative Organization, International Organization for Standardization, Lloyds, Organization for Economic Cooperation and Development; European Nuclear Energy Agency, and United Nations. (15 references) (M.L.S.)

48654 (ORNL-TM-2241) FUEL ELEMENT FABRICATION COSTS FOR DRAGON PROJECT LOW-ENRICHMENT, HIGH-TEMPERATURE GAS-COOLED REACTOR CONCEPT. Pratt, R. B.; Goldman, A. E. (Oak Ridge National Lab., Tenn.). Sept. 1968. Contract W-7405-eng-26. 19p. Dep. CFSTI.

Fuel element fabrication costs were estimated for a proposed low-enrichment Dragon Project HTGR concept. The fuel element consists of five annular graphite cylinders filled with bonded coated particles. The cylinders are joined at the element base by integral graphite webs which are slotted to permit coolant passage. Fabrication processes investigated included purchase and machining of graphite, fuel kernel preparation, particle coating, element loading and bonding, and inspection. On the assumption that the production requirements for 1-, 10-, and 30-reactor industry sizes would be 80, 800, and 2400 kg U/day, it was estimated that the fabrication costs would be $166.28, $108.38, and $98.23/kg of heavy metal, respectively, for elements loaded with PyC/SiC/PyC-coated sol-gel UO_2 fuel. (auth)

48655 (ORNL-TM-2347) FAILURE MODES OF ZIRCALOY-CLAD FUEL RODS. Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). Sept. 13, 1968. Contract W-7405-eng-26. 70p. Dep. CFSTI.

The behavior of the Zircaloy-clad UO_2 fuel rods during a loss-of-coolant accident in a modern light-water reactor is investigated. Attention is called to the possible detrimental effect of fuel rod failure on the efficiency of the emergency core cooling system and the subsequent chain of events in the accident. Existing programs and data relevant to the accident behavior of these rods are reviewed. Research and testing necessary to resolve the questions on fuel rod behavior are described. (auth)

48656 (RT/EC-(68)1) NUCLEAR POWER PLANTS' OPERATION: STATISTICAL REMARKS. Maccazzola, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 49p. (In Italian). Dep.

A whole inventory of the installed nuclear capacity is given for every country. The performances of each power station as far as the produced energy, capacity factor and availability is concerned are presented. (auth)

48657 (TID–24680) [FAST REACTOR FUELS AT THE KARLSRUHE FACILITY IN GERMANY]. Monthly Report No. 46. Macherey, Robert E. (Argonne National Lab., Ill.). Aug. 1968. 7p. Dep. CFSTI.

Irradiation programs are described for various composition PuO_2-UO_2 fuels. Cladding performances are also described. Fuel cladding properties of Mo- and V-alloys are presented. (D.C.C.)

48658 (WCAP–3850-3) POST-IRRADIATION EXAMINATION OF CVTR FUEL ASSEMBLIES. Semiannual Progress Report for Period Ending June 30, 1968. Balfour, M. G. (ed.) (Westinghouse Electric Co., Pittsburgh, Pa. Atomic Power Div.). Aug. 1968. Contract AT(30-1)-3850. 131p. Dep. CFSTI.

REACTOR FUEL ELEMENTS—assemblies of irradiated CVTR, nondestructive examinations of; cladding for CVTR rod-type, radiation effects on Zircaloy-4; characteristics of CVTR failed, tabular summary of; metallographic analysis of failed CVTR, results of; gamma scanning of failed CVTR, results of; profilometer tests on failed CVTR, results of; fission gas analysis of failed CVTR; cladding for irradiated CVTR, burst testing of; cladding for CVTR, steam-temperature induced corrosion of; welding of CVTR, tabulation of data on; cladding of CVTR, mechanical properties of

CAROLINAS-VIRGINIA TUBE REACTOR—fuel elements for, results of nondestructive examination of irradiated; fuel elements for, summary of characteristics of failed; fuel rods for, welding data on; fuel elements for, mechanical properties of cladding for (M.L.S.)

48659 COOLING WATER INTAKES AT WYLFA NUCLEAR POWER STATION. Civil Eng. Public Works Rev., 63: 759-61(July 1968).

The two sea water intakes, sited 600 ft. offshore, and their associated shafts and sea tunnels are described. (UK)

48660 ANALYSIS OF PRESSURIZATION OF REACTOR BUILDINGS FOLLOWING A COOLANT LOSS ACCIDENT. Eletti, G. F.; Romanacci, R. (CNEN, Rome). Ing. Nucl., 9: No. 2, 13-20(Mar.-Apr. 1968). (In Italian).

A blowdown analysis is given for water cooled reactors. Containment vessel pressure is shown as a function of time following coolant loss. General considerations are tabulated; a model for formulation of analytic expressions is discussed. Limitations to theory are described; data and calculations are given. (M.L.S.)

48661 NUCLEAR PLANTS FOR THE PRODUCTION OF ENERGY AND THE PURIFICATION OF WATER. Merlini, Cesare; Lazzerini, Renato (Politecnico, Turin). Ing. Nucl., 9: No. 2, 21-31(Mar.-Apr. 1968). (In Italian).

Use of reactors for power production and water purification is discussed. The advantages and disadvantages of a dual-purpose system are outlined; the economics of such systems is evaluated.

The performance ratio for desalination reactors is shown graphically; schematics of a dual-purpose plant are given using a boiling water and a pressurized water reactor. (M.L.S.)

48662 IN-CORE INSTRUMENTATION FOR A LIQUID-COOLED THERMAL POWER REACTOR. Cesari, F. (CNEN, Rome). Ing. Nucl., 9: No. 2, 33-60(Mar.-Apr. 1968). (In Italian).

The basic philosophy of reactor instrumentation is discussed; examples of in-core instrumentation are given. Locations of instruments are shown for various existing reactor cores; these are discussed briefly. Characteristics of various thermocouples, including high temperature thermocouples, are tabulated; primary of thermocouple error are listed. The uses of in-core thermocouples are summarised. Chemical composition and physical properties of materials for use as thermocouple sheaths are tabulated. Results of coolant void fraction measurements are tabulated; other hydraulic measurements are described. In-pile loops for fuel element instrumentation studies are described. The functions of instrumentation in organic and boiling water reactor cores are tabulated. 47 references. (M.L.S.)

48663 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Campion, Peter (to United Kingdom Atomic Energy Authority). British Patent 1,125,810. Sept. 5, 1968. Filed Nov. 16, 1965.

A description of a cooling system for a CO_2-cooled graphite-moderated nuclear reactor is presented. The cooling system contains a supported Ni catalyst to promote methane production from CO and H_2. (D.C.C.)

48664 BY-PASS CONTROL FOR NUCLEAR REACTOR PLANTS. (to Licentia Patent-Verwaltungs-GmbH). British Patent 1,125,387. Aug. 28, 1968. Priority date Dec. 3, 1964, Germany.

A description of a live-steam line in a nuclear reactor power generating system is presented. The steam line consists of a turbine flow regulating valve with a quick-acting cut-off valve, a by-pass steam line with a quick-acting opening valve and flow regulating valve, and a second by-pass steam line with a quick-acting opening valve and auxiliary flow regulating valve. (D.C.C.)

48665 CONCRETE IN NUCLEAR POWER. Campbell-Allen, D. (Univ. of Sydney). At. Energy Aust., 11: No. 3, 2-6(July 1968).

The increasing use of concrete in structures for nuclear power plants is examined. Design, construction, and safety aspects of large prestressed concrete pressure vessels and reinforced or prestressed concrete containment structures are discussed. (H.D.R.)

48666 REACTOR CONTAINMENT SYSTEMS (CONTAINMENT BUILDINGS, FILTERS, ABSORBERS, SHOWERS). Bernot, Natan; Alujevic, Andro. Nukl. Energ., 5: 9-14(1968). (In Slovak).

Three types of containment buildings for nuclear power stations, as well as their comparison with regard to usability and reliability in normal operation and in cases of accident, are described. The criteria for their application in respect of the population density around the nuclear power stations are also described. (auth)

48667 NUCLEAR FUEL AND THE DEVELOPMENT OF NUCLEAR POWER IN YUGOSLAVIA. Salom, Suica. Nukl. Energ., 5: 1-4(1968). (In Slovak).

The effects of alternative reactor strategies on U consumption for an anticipated long term development of nuclear power in Yugoslavia are described. The estimates cover annual and cumulative U consumption, Pu production and consumption for the future alternative reactors and their combinations: the light water reactor (LWR), the heavy water reactor (HWR), the LWR plus FB combination (FB for fast breeder), and the HVR plus FB combination. (auth)

48668 HETEROGENEOUS NUCLEAR REACTOR OF THE PRESSURE VESSEL TYPE. Braun, Wolfgang; Winkler, Franz (to Siemens Aktiengesellschaft). U. S. Patent 3,392,087. July 9, 1968. Priority date Aug. 8, 1964, Germany.

A heterogeneous nuclear reactor of pressure vessel type controlled by control rods and moderated and cooled with water at supercritical temperature and pressure is described. The reactor core comprises a plurality of fuel rods in grid-like arrangement and moderator elements inserted in grid-like distribution between said fuel rods, each of said moderator elements comprising a tube. A supply tube means is connected to said moderator tubes for supplying at least a portion of fluid coolant to said fuel rods through said moderator tubes with regulating valve means for controlling the reactor in addition to the control rods. The regulating valve means is connected in said supply tube means, and throttling means is located in said moderator tubes. (Offic. Gaz.)

48669 FUEL ARRANGEMENT FOR FAST BREEDER REACTOR. Visner, Sidney (to Combustion Engineering, Inc.). U. S. Patent 3,396,078. Aug. 6, 1968. Filed Dec. 23, 1966.

A fuel arrangement for a fast breeder reactor to lower or make negative the coolant void or coolant density coefficient of reactivity is described. The core fuel material and the blanket breeding material are arranged in a three dimensional checkerboard so as to provide enhanced neutron leakage from the fuel material to the blanket material upon a reduction in the coolant density or a voiding of the coolant. (Offic. Gaz.)

48670 FAST BREEDER REACTORS FOR NUCLEAR POWER STATIONS. Haefele, W.; Smidt, D. (Kernforschungszentrum, Karlsruhe, Ger.). Brennst.-Waerme-Kraft, 20: 372-8(Aug. 1968). (In German).

The fast breeder reactors will become increasingly important in the 1970's for power generation in Germany. Na and a Na cooled prototype reactor of 300 MW(e) are being designed and if the experimental programmes are successful the construction of these should be started between 1969 and 1971. From 1980 onwards commercial installations could go into service. The aim, organization and time schedule of the project "Fast Breeder"; the technical design of the Na and steam cooled prototypes; the reactor safety and siting; and the economics and fuel consumption of fast breeders are described. (auth)

48671 IMPROVEMENTS IN OR RELATING TO HIGH TEMPERATURE GAS COOLED REACTORS. Marien, Pierre Jean Camille Albert (to United Kingdom Atomic Energy Authority). British Patent 1,126,323. Sept. 5, 1968. Filed Jan. 8, 1965.

A description of a fuel assembly for high-temperature gas-cooled reactors is presented. The fuel assembly consists of a columnar moderator block with multiple parallel symmetrically arranged channels for fuel and coolant. The outer surface of the columnar block is covered with a hexagonal-shaped sleeve. (D.C.C.)

48672 NUCLEAR REACTOR AND CONTROL ROD THEREFOR. (to Combustion Engineering, Inc.). British Patent 1,126,585. Sept. 5, 1968. Priority date Dec. 30, 1964, United States.

A description of control element for a heterogeneous reactor is presented. The control rod consists of multiple suspended rectangular plates arranged with a cross-shaped cross-section. (D.C.C.)

48673 PROCESS FOR THE PURIFICATION OF MODERATOR WATER IN NUCLEAR REACTORS. Dolle, Lucien; Ledoux, Andre (to Commissariat a l'Energie Atomique). British Patent 1,126,546. Sept. 5, 1968. Priority date Dec. 30, 1965, France.

A description of the purification process for heavy water in heavy water-moderated reactors is presented. The heavy water is contacted with anionic and cationic ion exchangers for removal of aluminum. A flow diagram is described. (D.C.C.)

48674 PRESSURE SUPPRESSING ARRANGEMENT. (to Westinghouse Electric Corp.). British Patent 1,126,666. Sept. 11, 1968. Priority date Feb. 18, 1966, United States.

A description of a pressure suppression system for a pressurized-water reactor is presented. The suppression system consists of a compartment which receives the escaping high pressure coolant. An adjacent compartment filled with ice melts and forms a liquid mixture with the escaping coolant. (D.C.C.)

48675 METHOD OF OPERATING A GAS COOLED NUCLEAR REACTOR. (to Gutehoffnungshutte Sterkrade, AG). British Patent 1,126,397. Sept. 5, 1968. Priority date Sept. 9, 1966, Germany.

A description of a cooling system for a gas-cooled reactor is presented. The gas coolant enters as two separate streams with different temperatures. The cooler gas stream flows around the inner surface of the pressure vessel before entering the core. The warmer gas stream flows directly into the core. Both streams are discharged together. (D.C.C.)

48676 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). British Patent 1,126,367. Sept. 5, 1968. Priority date Feb. 8, 1965, United States.

A description of a pressurized-water reactor is presented. The reactor core contains fuel-free zones which are filled by gas under pressure. The zones can be filled by moderating water by varying the gas pressure. (D.C.C.)

48677 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS FOR STEAM GENERATION PARTICULARLY FOR USE IN NUCLEAR POWER PLANTS. Krizek, Vladimir (to Prvni Brnenska Strojirna, Zadovy Klementa Gottwalda Narodni

Podnik). British Patent 1,126,350. Sept. 5, 1968. Filed Nov. 2, 1965.

A description of a boiler for a nuclear power plant is presented. The boiler consists of multiple vertical rows of straight suspended elements. Steam and water drums are positioned laterally along and outside the vertical parallel rows. (D.C.C.)

48678 BRITISH GAS COOLED NUCLEAR REACTOR. Wolff, P. H. W. Elektrotech. Maschinenbau., 85: 222-4(May 1968). (In German).

In England 22 reactors of the gas-cooled type are in operation in 9 power plants; 6 more are under construction, 4 are ordered, and there are plans for 6 more. The present program reaches 12.5 GW. The first reactors produced 40 MW; the most recent, 4 units at Heysham, each produce 625 MW. All units in operation before 1969 are natural U. The advanced gas cooled reactor uses UO_2 at higher temperatures with a stainless steel can; exit temperature of the gas is 675°C. Steam properties are 160 atm/538°C/538°C; efficiency is 42%. The unit is developed for fuel conversion at full load. The first commercial advanced gas reactor is at Dungeness (Dungeness "B" station), which will go on stream in 1970. Plans for reactors for this installation are illustrated. The fuel elements developed at Windscale are UO_2, 1 m long, with 36 rods of 14.5 mm dia, sintered in tablets, with a density 100% of theoretical. (BBB)

48679 ALARM ANALYSIS AND INDICATION AT OLDBURY NUCLEAR POWER STATION. Kay, P. C. M.; Heywood, P. W. pp 446-55 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967.

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

At the Oldbury power plant, the 2,000 to 3,000 alarm conditions which may arise are fed to an A.E.I 1040 process computer. The computer analyzes the alarm patterns, deduces the causes, and eliminates all those alarms which have arisen as side effects of other more important alarm conditions. The result of the analysis is displayed on a cathode ray tube in the control room, and all alarms are logged on a teleprinter. The equipment used and the principles of operation are described. (H.D.R.)

48680 REFLECTION ON THE OPTIMIZATION OF THE FUEL CYCLE OF A BOILING WATER REACTOR USING PROCESS COMPUTERS. Wolff, Ulrich (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main). pp 415-19 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. (In German).

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

The possibility of optimizing fuel use in boiling water reactors using small process computers is examined. The computer would use in-core measurements to determine the spatial power distribution and instruct control systems to make adjustments to attain a desired distribution. The power density of fuel could be increased by 10 to 20% using process computers only. (H.D.R.)

48681 UTILIZATION OF THE NUMERICAL COMPUTER FOR SEQUENCE AUTOMATION IN THE EDF-4 POWER PLANT. Arnault, P.; Levy, J. pp 404-14 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. (In French).

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

The system for automatic control of the EDF-4 power plant using a digital computer is described. The sequence of acquisition and analysis of analog measurements from the plant components is examined, and the equipment, circuits, and programs used are described. (H.D.R.)

48682 ELECTRONIC EQUIPMENT FOR DATA PROCESSING IN A LARGE NUCLEAR POWER PLANT. Hubaut; Avet. pp 384-90 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. (In French).

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

Problems in the automation of nuclear power plants to assure safety and dependability are discussed. The concept of combining various control subsystems is examined, and the specific functions of the subsystems are described. (H.D.R.)

48683 AUTOMATION OF THE FRANCO-BELGIAN ARDENNES POWER PLANT. Couez, Henri. pp 232-8 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. (In French).

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

A concept for complete automation of the functional control of the Ardennes plant is described. The concept is based on splitting the control process into a number of "functions", each of which is associated with an "automate". The automates contain permanent records of information necessary for logic subsystems to carry out the required control functions. This allows the subsystems to perform the control function in the simplest and safest manner instead of through rigid preestablished sequences. (H.D.R.)

48684 CONTROL AND HANDLING OF INFORMATION AT THE ARDENNES NUCLEAR POWER PLANT. Touchard; Boulet. pp 188-201 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. (In French).

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

Control methods employed in the Ardennes pressurized water power reactor are described. Reactivity control is obtained through control rod movement or the addition of boric acid to the primary loops. Other circuits control the pressurizer, the steam by-pass system, and the steam generators. Some of the automatic control functions and data processing performed by the PSP 100 digital computer which is associated with the controllers are described. (H.D.R.)

48685 EXAMINATION OF THE CONTROL BEHAVIOR OF BOILING WATER REACTOR POWER PLANTS USING AN ELECTRONIC COMPUTER. Reinhardt (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main). pp 107-10 of Automatic Control in Production and Distribution of Electrical Power. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. (In German).

From International Seminar on Automatic Control in Production and Distribution of Electrical Power, Brussels, Belgium.

The application of digital computers to boiling water power reactor control systems is reviewed. Some of the control functions performed by the digital programs are examined. (H.D.R.)

48686 AUTOMATIC CONTROL IN PRODUCTION AND DISTRIBUTION OF ELECTRICAL POWER. International Seminar, Brussels, 18-22 April 1966. Actes Proceedings. Willems, P. (ed.). Brussels, Presses Academiques Europeennes, 1967. 606p. $33.00. (In Several Languages). (CONF-660463).

Included are 58 papers on automatic control methods and equipment in thermal, nuclear, and hydro electrical power generating facilities and in electrical network operation. Individual abstracts were prepared for each of 7 papers dealing with control aspects of nuclear power reactors. (H.D.R.)

For abstracts of individual papers see: 48679–48685.

48687 THERMAL POLLUTION. Muskie, Edmund S. (U. S. Senate, Washington, D. C.). New Engl. J. Med., 278: 677-8 (Mar. 21, 1968).

The problem of effluents from nuclear power plants which raise the temperature or river and coastal water is briefly considered. Because generators of electrical energy are the greatest consumers of water for the purpose of cooling and condensing, a Senate subcommittee is directing its attention initially to this facet of the problem. The subcommittee hearings will attempt to create a public awareness so that in applying technologic advances the need to maintain a balanced environment is not ignored. Information developed by the subcommittee hearings will emphasize the need to consider the long-term effects of heated waste water on ecologic communities, by studies both before and after a power plant goes on the line. (BBB)

48688 EXPERIMENTAL STUDY ON THE VIBRATIONS OF VARIOUS FUEL ROD MODELS IN PARALLEL FLOW. Basile, D.; Faure, J.; Ohlmer, E. (EURATOM, Ispra, Italy). Nucl. Eng. Design, 7: 517-34(1968).

The parallel flow vibrations in different types of fuel element cans were studied by means of tests in air and in water. The vibration amplitudes of an isolated rod are represented in a correlation incorporating the main geometric and hydrodynamic parameters. The additional effect of flow asymmetry and of some technological parameters (pumps, grids, play in the attachments) is demonstrated. The experimental results are analyzed and compared with those of other experiments. The tests described are part of a technological study on the risks of wear and hammering entailed by the variations of fuel elements in an ORGEL-type channel. (auth)

48689 NUCLEAR STATIONS WITH GAS COOLED HIGH TEMPERATURE REACTORS. Fischer, Peter U. Elektrotech. Maschinenbau., 85: 213-16(May 1968). (In German).

The advantages of the high temperature gas-cooled reactor are reviewed. The state of development of such reactors is noted: early models like the Dragon Project of the OECD and the AVR test reactor at Juelich are described. Particular attention is paid to the installations at Peach Bottom, Pa., and Fort St. Vrain, Colo. Plans for future reactors are noted. (BBB)

48690 THE SUPPLY OF POWER IN SWEDEN AND THE ASEA BOILING WATER REACTOR. Ericsson, Ove Elektrotech. Maschinenbau., 85: 210-12(May 1968). (In German).

Power requirements in Sweden will increase at 7.2% per year. By 1975 nuclear power stations with a total delivery of 2 GW(e) and by 1980, 6 GW(e), will be needed. ASEA today has stations at Ågesta, Markiven, and Oskarshamm in operation or in stages of construction. The pressure unit of the ASEA boiling water reactor is illustrated and described. The plans for the station at Oskarshamm are sketched. (BBB)

48691 NUCLEAR POWER STATION IN THE AUSTRIAN ELECTRICITY ECONOMY. Kothbauer, Alexander. Elektrotech. Maschinenbau., 85: 193-7(May 1968). (In German).

A short history of power requirements and the methods employed to meet them since the end of World War II is first given along with a short history of nuclear power. The Austrian situation is first confronting the necessity for nuclear power at a time when other countries have built classical power stations and are experimenting with newer models. A nuclear station smaller than 300 MW(e) would be unsatisfactory; use of power will double in 10 years according to one prediction, or will increase by 6% annually, according to another. A discussion of factors determining the best location leads to a choice for the first plant on the Danube either near Vienna or near St. Peter. Cost comparisons for a 360-MW(e) nuclear station and a similar conventional oil station are drawn. (BBB)

48692 PRESSURIZED WATER REACTORS. Keller, Wolfgang. Elektrotech. Maschinenbau., 85: 216-19(May 1968). (In German).

Principles of pressurized water reactors are reviewed. Advantages of such reactors are reviewed. Low cost of the installation is noted, with attention drawn to the 300 MW(e) plant at Obrigheim. Fuel investment has been lowered to 130 DM/kW. Fuel costs are dropping as a result of recent developments. Reliability of operation has been established with prototypes at Shippingport and Yankee, with closed cycles, and the simplicity of the coolant water, which also serves nicely as a protection during repairs, especially when the reactor is opened. Behavior in operation and regulation are reviewed. Conveniences when the load is varied include only small changes in temperatures in turbines as well as the reactor. Units up to 600 MW(e) show no instability in Xe variations. Safety features are noted: the negative power coefficient and the mode of construction of the pressure unit are particularly valuable. (BBB)

48693 PRODUCTION AND CONSUMPTION OF PLUTONIUM. Gibas, H. Bull. Ass. Suisse Elec., 59: 608(June 22, 1968). (In French).

Because Pu is the fuel for the fast power reactors which will become the principal means of energy production in the future, a review of its supply is presented. Reactors fueled by U produce Pu, with specific production (g Pu/MW) highest at the beginning of the service period. Thus, short-term operation modes would be advisable; but this is not a workable arrangement for the usual power reactors and central stations. For several years, demand for Pu will exceed the supply; only by 1975, when 34,000 Kg will be produced in western countries, will there be enough Pu to meet demand. In France and Great Britain there is currently a sufficient amount of Pu. In the United States and Germany, there is a deficit; in Belgium and the Netherlands, there will probably be a surplus. The situation in Italy is unclear. Towards the end of the 1970's, the excess of Pu will again decrease, and another period of a deficit is probable. As development continues, an equilibrium between supply and demand will be established. (BBB)

48694 ON THE EXISTENCE AND UNITARITY OF A POSITIVE SOLUTION OF ONE CRITICAL REACTOR EQUATION. Shikhov, S. B.; Shishkov, L. K. Zh. Vychisl. Mat. i Mat. Fiz., 8: 686-90 (May-June 1968). (In Russian).

The reactor criticality equations are written out in respect to neutron density. An analysis is made of the equations. (R.V.J.)

48695 PLANNING FOR POWER: A LOOK AT TOMORROW'S STATION SIZES. Bennett, R. R. (Ebasco Services Inc., New York). IEEE (Inst. Elec. Electron. Eng.), Spectrum, 5: No. 9, 67-72(Sept. 1968).

Favorable sites for utility power stations are becoming more difficult to obtain due to the demands of other industries and urban developments. A utility must plan for generating facilities long in advance of the time they are needed to meet system load growth. A major problem will be to find sufficient sites for the required generating facilities to meet the system demands. Successful planning must consider the types and sizes of generating equipment to come. The future forecast of unit and plant sizes for which plans must be made in the next 20 years is presented. (auth)

48696 THE AEG BOILING WATER REACTOR. Traube, Klaus. Elektrotech. Maschinenbau., 85: 219-21(May 1968). (In German).

The principles of the AEG boiling water reactor are reviewed with a schematic of the main cycle; efficiency reaches 33 to 34%, with 70 atm and 286°C considered moderate conditions in the reactor. Economic and technical optimization leads to 22 MW(t)/ton U and 27,500 MWd/ton U at 2.6% enrichment. The most important of such units in operation are Vallecitos, 10 MW(e); Dresden I, 200 MW(e); Kahl, 16 MW(e); Garigliano, 150 MW(e); Gundremmingen, 240 MW(e). Details of the construction of a typical combustion unit are provided. New units about to go on-stream or under construction are: Lingen, 240 MW(e); Wuergassen, 640 MW(e). Safety features developed by AEG are discussed, particularly the safety container for the Wuergassen installation, which is schematically illustrated. (BBB)

48697 PROSPECTS FOR NUCLEAR ENERGY IN WESTERN EUROPE: ILLUSTRATIVE POWER REACTOR PROGRAMMES. Searby, P. J. Atom, No. 143, 247-54(Sept. 1968).

Comments are presented on the 1968 report of the Study Group of the European Nuclear Energy Agency set up in 1964 to investigate nuclear energy as a long term resource in Western Europe. Headings are as follows: history of Study Group; nuclear demand forecast; illustrative reactor programmes; computer techniques; uranium requirements; requirements for fuel services; sensitivity analysis; and conclusions. (UK)

48698 FACTORS EFFECTING THE VALUE OF HEAT TRANSFER AGENT HEATING IN WATER-COOLED REACTORS UNDER PRESSURE. Ul'fskii, G. V. Inzh.-Fiz. Zh., 15: 35-9(July 1968). (In Russian).

The effects of various atomic power plant parameters with PWR on the value of the coolant heating in the reactor core are described. Formulas and graphs are presented which allow determination of the coolant heating value with respect to the reference data in carrying out multi-variant calculations. (auth)

48699 MODERATOR REFLECTOR FAST NEUTRON REACTOR CORE. (to United States Atomic Energy Commission). British Patent 1,128,073. Sept. 25, 1968. Priority date Oct. 12, 1965, United States.

A core configuration for a fast nuclear reactor is described. The core consists of mutually concentric annular cylindriform zones arranged from the exterior zone as: an outer first neutron reflector; a first breeder blanket zone; a second neutron reflector zone; a first buffer zone; a fissile fuel zone; a second buffer zone; a third neutron reflector zone; a second breeder blanket zone; and a central neutron reflector zone. Coolant channels and mechanical control elements penetrate the core axially. (D.C.C.)

48700 HETEROGENEOUS ATOMIC REACTOR. Seltorp, Jonas Leonard. U. S. Patent 3,398,051. Aug. 20, 1968. Priority date Feb. 6, 1963, Sweden.

A heterogeneous reactor with a substantially spherical reactor tank having parts wherein the neutron flux is strong and parts wherein the neutron flux is of less strength is described. The reactor fuel is easily replaceable and rearrangeable so as to reach a high and smooth burnup. A molten coolant carries fuel elements in the shape of spherical bodies containing fuel in a partly molten state. Coolant channels communicate with spherical spacing within the bodies. The specific gravity of the fuel bodies is at least substantially equal to that of the coolant. Diametrically opposite sections of the reactor tank are provided with connections divided into at least two groups. One central group has inlets and outlets for the cooling medium positioned diametrically opposite to each other which central group has a flow through direction of the cooling medium always the same. A second group of connections is placed round the central group. Coolant flow-through direction may be reversed through the second group of connections. In running state the entire cross-section of the reactor is flowed through by the cooling medium in a parallel flow to ensure that the fuel elements are kept in a fixed position in the tank by a hydrodynamic pressure. In a fuel rearrangement state, when the flow-through direction through the second group of connections is reversed the cooling medium moves in a whirling motion in the tank to rearrange the fuel elements in a transport cycle from the central part of the tank, where the neutron flux is high to more peripherically situated parts, where the neutron flux is lower. (Offic. Gaz.)

48701 NUCLEAR REACTOR SYSTEM. Yevick, John G.; Brill, Edward F. (to Atomic Power Development Associates, Inc.). U. S. Patent 3,398,050. Aug. 20, 1968. Filed Jan. 7, 1966.

A nuclear reactor having a first region which contains a reactor core and blanket portions and a superadjacent region which is a core decay region is described. A plurality of liner tubes are provided, each of which contains subassemblies. Each of the tubes has a substantially constant cross-sectional area throughout the portion in the first region, and a larger second substantially constant cross-sectional area throughout the portion in the second region. Means are provided for moving selected subassemblies from the first region to the second region, as well as means for retaining the subassemblies within the second region. (Offic. Gaz.)

48702 ENERGY. Proceedings of the Seventh Biennial Gas Dynamics Symposium, Evanston, Ill., August 23-25, 1967. Holmes, Lawrence B. (ed.). Evanston, Ill., Northwestern University Press, 1968. 180p. $12.00. (CONF-670843).

A separate abstract is included for the paper which deals with nuclear energy. (D.C.C.)

For an abstract of the individual paper see: 48703.

48703 FUTURE USE OF NUCLEAR ENERGY IN THE POWER INDUSTRY. Anderson, Guveren M. pp 51-62 of Energy. Holmes, Lawrence B. (ed.). Evanston, Ill., Northwestern University Press, 1968.

From 7th Biennial Gas Dynamics Symposium, Evanston, Ill. See CONF-670843.

The nuclear fuel supply problem is reviewed in relation to the use of water-cooled reactors, advanced converters, and breeders. The establishment of several AEC task forces to assess the variables involved is discussed. The development alternatives in the heavy water-moderated reactor program are described. Possible uses of 1000 MW(e) water-cooled reactor plants and future breeders producing very low cost power are explored. (auth)

48704 THE TESTING OF SAFETY OF NUCLEAR ENERGY PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Kellermann, Otto. Elektrotech. Maschinenbau, 85: 235-8(May 1968). (In German).

Legal requirements for testing are set forth. Special areas are designated as: boiler, pressure container, electrical installation, regulation and distribution, lifting apparatus, heat transfer, emission and immission protection, feed water, corrosion, and working materials. The organization of jurisdiction over such matters in Germany is outlined; the power over operations is jointly held by state authorities and the local Technical Supervision Union. The course of approval of installations is described, and analysis of accidents is demonstrated as the foundation for testing for technical safety. Testing during construction is described. Repetitive testing while the unit is in use is noted, and finally the way in which results of tests are used is described with statistical data. (BBB)

48705 SPECIAL PROBLEMS OF THE EXTERNAL FUEL CYCLE OF A NUCLEAR POWER PLANT. Jelinek-Fink, Peter. Elektrotech. Maschinenbau, 85: 250-2(May 1968). (In German).

Several points are peculiar to nuclear power stations from an economic or technical viewpoint and do not apply to the classical coal and oil plants. These are the particular properties of U, the early technical stage of development of plants for the single enrichment steps for U, the monopolistic position of some plants processing U, and the difficulties in exact prediction of a power station's requirements (particularly with reference to reuse of U and Pu from workup). Conditions of the present U market are reviewed. American and possibly British private conversion plants are noted in addition to the AEC installation. The NUKEM fuel elements and the European recycling workup plant in Mol (Eurochemic) are discussed from a cost viewpoint for continental use. Two reenrichment possibilities are available: mixture with fresh, very highly enriched material, or recycling through the AEC gas diffusion unit. The application of Pu produced in the recycling plant is discussed. Future availability of Pu leads to a predicted price in the range of $7 to $8/g. (BBB)

48706 NUCLEAR REACTOR. Leroy, Claude; Narcy, Jack; Treille, Pierre (to INDATOM). British Patent 1,128,255. Sept. 25, 1968. Priority date May 14, 1965, France.

A description of a power reactor which has a pressure vessel-enclosed heat exchanger is presented. The heat exchanger consists of multiple consecutive hairpin loops forming accurate vertical layers in the form of circle involutes around the core shell. The heat exchanger is located directly beneath the core. (D.C.C.)

48707 SAFETY OF NUCLEAR POWER PLANTS. Gruemm, Hans. Elektrotech. Maschinenbau, 85: 225-35(May 1968). (In German).

A review of results, principles, methods, present state and future developments in safety considerations in nuclear power stations is given. Fatal accidents in nuclear plants from 1944 to 1964 are listed. Limits for radiation effects, particularly those set by the International Commission for Radiological Protection, are noted. The derivation of maximum doses for irradiation of individual organs and the assignment of values for nuclides in air and water is noted. (BBB)

48708 VIEWPOINTS ON THE CHOICE OF THE REACTOR TYPE FOR THE FIRST AUSTRIAN NUCLEAR POWER PLANT. Gilli, Paul Viktor. Elektrotech. Maschinenbau, 85: 197-209(May 1968). (In German).

The construction of a 300- to 400-MW nuclear power plant is foreseen soon in Austria, and the type of plant is still undecided. At least 1 unit or prototype must be in operation or construction and serviced by at least 1 firm. Possible types include DWR, SWR, SGHWR, CANDU, Magnox, AGR, and HTR. The coolant, moderator, fuel, enrichment, container, national origin, and firms employing these types are tabulated. Thermal data are also reviewed: the maximum coolant temperature, pressure, vapor temperature, mean overheating, efficiency, and type of construction for each of these types are also tabulated. Part of the choice will rest on the location of the plant; 2 sites in the region of the Danube are suggested. One is near Vienna. The information presented is that given to the Austrian electrical economy as material on which to base a final decision for the type of reactor employed. (BBB)

48709 DEVELOPMENT OF THERMAL REACTORS. Schmidt, G. (Berliner Kraft- und Licht, Berlin). Brennst.-Waerme-Kraft, 18: 283-4(June 1966). (In German).

Results of an analysis on the economy of nuclear power plants are given. In Germany only the light water moderated pressurized- and boiling-water reactors are industrially practical. Total installation costs of the plant approach those of coal and oil plants of the same power as the power increases. Costs for going on-stream are compared with oil as a function of fuel cost and duration of use. A 600-MW nuclear plant would have 1 Dpf per kWh lower stream costs than a coal and oil-powered plant. A breakdown of stream costs for all three types of plants producing 600 MW is given. The dependence of stream attainment costs on the price of U is expected to be very small. A doubling of the price of U from $8 to $16/lb U_3O_8 would change costs by only about 10%. (BBB)

48710 DEVELOPMENT IN REACTOR BUILDING DESIGN FOR CANDU-TYPE NUCLEAR POWER PLANTS. Williamson, R. L. (Canadian General Electric Co. Ltd., Peterborough, Ont.); Rafferty, W. P. Eng. J. (Montreal), 50: 41-8(Oct. 1967).

The CANDU-type reactor uses heavy water as a moderator and Zircaloy-sheathed natural UO_2 fuel rods. Five stations have been designed using pressurized heavy water in the primary heat transport system. A boiling light water prototype is currently being engineered. High and economical fuel burn-up is obtained by means of on-power fueling, an important feature of the CANDU design. Requirements for the layout and design of buildings for a nuclear generating station are discussed, particularly with regard to radiation and contamination problems and hazards. The vertical heavy water reactor building design is diagrammed. A unique system has been evolved for the Pickering zero leakage containment, consisting of individual reactor buildings, a pressure balancing duct containing isolating valves, and a vacuum building. This design reduces containment building expenditures by eventual distribution of the vacuum building cost among 4 reactors. Examination of tabulated cost data reveals that simplification in reactor buildings design has resulted in capital cost savings with no increase in building cost per kW(e) despite a ⅓ reduction in rated plant output. Reactor building cost represents about 5% of total plant outlay. Accordingly, economies achieved in the building design may well represent a significant contribution to plant competitiveness. (BBB)

48711 SODIUM-COOLED FAST REACTORS. Bergstrom, R. N.; Chittenden, W. A.; McClintock, D. C. (Sargent and Lundy, Chicago). Power Eng., 71: 56-8(Oct. 1967).

Problems involved in the structural design and construction of reactors with liquid metal coolants are considered. (BBB)

48712 SODIUM-COOLED FAST REACTORS. Bergstrom, R. N.; Chittenden, W. A.; McClintock, D. C. (Sargent and Lundy, Chicago). Power Eng., 71: 70-2(Oct. 1967).

Mechanical and electrical aspects of Na-cooled fast reactors are reviewed. Liquid metal systems have been analyzed for the following conditions: normal design operating temperature and pressures, normal startup and shutdown cycle, isothermal conditions, oscillator test conditions, temperature coefficient tests,

coolant temperature transients, mild ramp and prompt critical tests, severe prompt critical tests, and various accident conditions. The stress components calculated for the various loading conditions are categorized. Heat loss calculations are also considered, to determine the amount of heat required to sustain an even temperature and to determine the heating rate necessary to bring the system up to the design temperature within a given time. (BBB)

48713 COMPUTER CONTROL OF THE HBWR. Lunde, J. E. RCN (Reactor Cent. Ned.) Meded., No. 31, 163-81(1968).

The objectives of the research program on on-line computer control to be carried out at the Halden Reactor Project in the period 1967–69 are discussed. Emphasis in the program is on control of processes in the core, but the final aim is an integrated control system covering the main parts of the reactor and its heat removal circuits. Computer hardware and instrumentation are described, and safety aspects are examined. The reactor plant lay-out, important in-core parameters that are measured, and intended computer control functions are discussed. (H.D.R.)

Marine and Portable Power Reactors

48714 (AED-C-22-10) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 22: NUCLEAR SHIP PROPULSION. (Zentralstelle fuer Atomkerenergie-Dokumentation, Frankfurt am Main (West Germany)). June 1968. 8p. (In German and English). Dep.

Included are 47 references on various aspects of the application of nuclear reactors for merchant ship propulsion. Author and subject indexes are included. (H.D.R.)

48715 (AERE-R-5500(Vol.2), pp 498-511) NUCLEAR REACTORS FOR UNDERWATER POWER. Hooper, A. T. (Atomic Energy Establishment, Winfrith (England)).

The interrelation between heat production in nuclear reactors, conversion of this energy to mechanical or electrical power, and the underwater environment is considered. The extent and form of the energy output required are currently hypothetical which prevents any precise recommendations being made as to the type of reactor systems suitable. However, some preliminary estimates have been made of the performance and unit generating costs which might be expected from reactor driven underwater power sources. (auth)

48716 PRESSURE VESSEL FOR A NUCLEAR-POWERED SHIP. Goto, Jiro (to Hitachi Ltd.). Japanese Patent 1968-8215. Mar. 29, 1968. Filed Oct. 9, 1964.

By the method proposed, when the ship is inclined and thus a pressure vessel is inclined, the exposure of the heaters can be prevented. The pressure vessel is dumbbell-shaped in an upright position. Upright heater rods and a central upright surge chamber are set in the lower spherical portion. Water fills the dumbbell pressure vessel up to a level in the part of the neck; the upper spherical portion is a room for the produced steam. (NSA of Japan)

48717 IMPROVEMENTS IN MARINE NUCLEAR REACTORS. Deighton, Thomas (to Babcock and Wilcox Ltd.). British Patent 1,125,758. Aug. 28, 1968. Filed Nov. 30, 1965.

A description of an integral water-cooled and -moderated maritime reactor is presented. The reactor is enclosed in a pressure vessel which is disposed within a dry well. The dry well is connected with a wet well containing water. Multiple ducts extending breadthwise of the ship connect the wet and dry wells. The ducts run in parallel curved lines so that the inlet ends open into the upper end of the dry well and the outlet ends open into the lower end of the wet well. (D.C.C.)

48718 VIBRATION OF THE FUEL ASSEMBLY OF A MARINE REACTOR. Takada, Y. (Ship Research Inst., Tokyo); Egusa, T. Nucl. Eng. Design, 7: 578-84(1968).

Experimental and theoretical investigations on the lateral vibration of a fuel rod assembly of a light water ship propulsion reactor in air and water medium are described. The dynamic behavior of the fuel assembly yielded design information needed for avoiding resonance vibration which could be induced by vibrations of the hull of the ship. (auth)

48719 NUCLEAR REACTOR CONTAINMENT SYSTEM. (to Westinghouse Electric Corp.). British Patent 1,127,558. Sept. 18, 1968. Priority date Nov. 22, 1966, United States.

A containment system for a nuclear ship reactor system is described. The reactor is enclosed in a containment vessel. A piping system connects the interior of the containment vessel with the enclosed space in the inner bottom of the ship. A valve in the piping remains normally closed. The valve opens upon rupture of the primary reactor vessel. (D.C.C.)

48720 NUCLEAR SUBMARINES OF ADVANCED DESIGN. HEARING BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, SECOND SESSION, JUNE 21, 1968. Washington, D. C., Joint Committee on Atomic Energy, 1968. 136p. GPO.

Statements on the status of developments in the U. S. nuclear submarine program are included. Recommendations concerning the construction of a turbine-electric drive quiet submarine and a high speed attack submarine are presented. (H.D.R.)

48721 NUCLEAR SUBMARINES OF ADVANCED DESIGN. PART 2. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETIETH CONGRESS, SECOND SESSION, JULY 25, 1968. Washington, D. C., Joint Committee on Atomic Energy, 1968. 106p. GPO.

Testimony is presented on the importance of prompt initiation of a development program on an electric-drive quiet submarine and a high-speed submarine. (H.D.R.)

Rocket and Space Reactors

Refer also to abstract 47241.

48722 (LA-3746) INTEGRAL GAMMA AND NEUTRON MEASUREMENTS ON THE PHOEBUS 1B REACTOR. Ahlquist, A. John (Los Alamos Scientific Lab., N. Mex.). Oct. 1967. Contract W-7405-eng-36. 31p. Dep. CFSTI.

Data on the neutron fluence and neutron and gamma doses measured during the four experimental plans involving criticality of the Phoebus 1B reactor are presented. The reactor was surrounded by a 360° open-well shield, which changed the leakage radiation pattern measured on previous unshielded reactor tests. The new radiation pattern is discussed and compared to earlier reactors. Also included are depth dose measurements in the shield and miscellaneous gamma measurements near the reactor. (auth)

Research and Test Reactors and Critical Assemblies

Refer also to abstract 48511.

48723 (BNWL-648) DECAY HEAT DEPOSITION FROM IRRADIATED FTR FUEL BUNDLE. Bunch, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 5, 1967. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

A preliminary evaluation of the decay energy distribution pattern in the FTR driver fuel bundle for determining the adequate cooling requirements in handling or storage is presented. Calculated decay heat plots for fuel operation at a fission power level of SMW to 45 MWD/kg are presented. Estimated axial distribution along the fuel region is shown. 10 references. (D.C.C.)

48724 (BNWL-762) EVALUATION OF NPTR/FTR NEUTRONICS DIFFERENCES. Baird, Q. L.; Engstrom, S. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 8, 1968. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

The degree of simulation of the FTR neutronics characteristics achieved by the NPTR reference design is described. The neutron flux spectrum and K_{eff} of the systems are indicators of system changes. Parameters such as the Doppler coefficient, reaction rates of ^{239}Pu fission, and boron absorption are considered. The differences in reactivity worths calculated for the FTR system and NPTR system are also important sensors. (auth)

48725 (BNWL-767) NPTR TERTIARY REACTIVITY CONTROL SYSTEM. Engstrom, S. L.; Ripfel, H. C. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1968. Contract AT(45-1)-1830. 15p. Dep. CFSTI.

A tertiary reactivity control system for the NPTR is described. The type of shutdown rod investigated consists of a blade rod of B_4C with a canned sodium section. The rods will move in rectangular guide tubes driven by electric motors and worn gears. Analyses of flooding accidents and achievable rod worths indicate that ample negative reactivities can be provided by this blade rod system. (auth)

48726 (BNWL–813) PRELIMINARY RELIABILITY PREDICTION FOR THE FFTF CONCEPTUAL BUILDING ELECTRICAL POWER SYSTEM, SYSTEM 12. Monteith, O. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 1968. Contract AT(45-1)-1830. 55p. Dep. CFSTI.

A reliability analysis of the FFTF Building electrical power system is given. Basic assumptions which underlie the analysis are listed. A systems block diagram for systems operational analysis is shown. One-line diagrams are included for: the 13.8 kV feeders with 24 kV and 480 V switchgear, 480 V a-c power, and 2.4 kV system. Equipment failure rates and restoration times are tabulated; the mathematical model used for analysis is given. (M.L.S.)

48727 (BNWL–834) TUBULAR FUEL ELEMENT WITH INTEGRAL TARGET: PCTR EXPERIMENT. Bennett, R. A.; Newman, D. F.; Vaughn, A. D.; Davenport, L. C.; Robertson, D. E.; Bennett, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1, 1968. Contract AT(45-1)-1830. 72p. Dep. CFSTI.

Two tubular fuel elements with integral target lattices have been investigated in the Physical Constants Test Reactor (PCTR). Multiplication constants, neutron utilization ratios, fast fission factors, and initial conversion ratios have been inferred from null reactivity experiments and measurements of spatial distributions of neutron reaction rates. Both wet and dry experiments were carried out in a three-by-three array of lattice cells 37.5" long placed in the cavity of the PCTR. (11 references) (auth)

48728 (GA–7472) CONCEPTUAL DESIGN OF A THERMIONIC CRITICAL EXPERIMENT FOR DOPPLER COEFFICIENT MEASUREMENTS. Cohen, S.; Moore, R.; Shanstrom, R.; Russell, J.; Mathews, D. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Nov. 15, 1966. Contract AT-(04-3)-167. 62p. Dep. CFSTI.

A planned critical experiment to aid in the analysis of the neutronic characteristics of thermionic reactors is discussed. The assembly for measurement of Doppler reactivity coefficients is a split-bed machine with ^{235}U-foil fuel. The Doppler samples are oxide or carbide spheres or carbide powder cooled and heated by helium gas. The nuclear analysis including considerations of assembly composition and sensitivity and the magnitude of the expected reactivity signals, the assembly and sample design including the attendant thermal analysis, the instrumentation considerations, the overall description of the facility, and a description of the planned spectrum measurements are presented. (H.D.R.)

48729 (IDO–17021(Rev.)(Vol.1)) SAFETY ANALYSIS REPORT, ADVANCED TEST REACTOR. deBoisblanc, D. R.; Cohen, S. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1965. Contract AT(10-1)-205. 306p. Dep. CFSTI.

Information on the Advanced Test Reactor (ATR) is given under the following broad headings: Introduction and Summary; ATR Site; Reactor Building; Reactor Structure, Shielding, and Equipment; Reactor Core; Primary Coolant System; and Instrumentation and Control. (M.L.S.)

48730 (IDO–17021(Rev.)(Vol.2)) SAFETY ANALYSIS REPORT: ADVANCED TEST REACTOR. VOLUME 2. deBoisblanc, D. R.; Cohen, S. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1965. Contract AT(10-1)-205. 609p. Dep. CFSTI.

Information on the Advanced Test Reactor (ATR) is given on: Control Rod Drives; Electrical Systems; Additional Coolant Systems; Auxiliary Systems and Machinery; Coupling between Reactors in the MTR-ETR-ATR Area; Emergency Evacuation Procedures; Initial Tests and Operating Procedures; Administrative and Procedural Safeguards; Accident Analyses; and Hazards Analysis. Appendices include: radiation effects on beryllium, environmental hazards, ATR fission product inventory after 17 days of operation, reactor building leak rate computations, research and development programs, and error propagation analysis of thermal burnout. (M.L.S.)

48731 (IFA-FR–41) THE POISONING WITH THERMAL FISSION PRODUCTS AT PERIODICAL OPERATION OF WWR-S REACTOR. Rosescu, T.; Pavelescu, M. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). Oct. 1965. 7p. Dep.

The values of poisoning for the reactor operating 6, 12, or 120 hours, in 1, 10, or 100 days at different moments after shut-down, are presented. Twenty eight stable products and 19 radioactive series are taken into account. The results obtained are compared with the results obtained for continuous reactor operation. (auth)

48732 (INR–919) DETERMINATION OF EPITHERMAL CELL PARAMETERS IN WWR-SM CRITICAL ASSEMBLY CORES. Jozefowicz, Edward T. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 16p. Dep.

Methods of epithermal cell parameters measurements in normal elementary cell of the WWR-SM type, multitube enriched fuel, water moderator, are described. The results of irradiations of fuel pellets in the investigated lattice are normalized to the thermal spectrum using Dy foils and irradiations in the thermal column. Integral counting of fission products and the chromatographic separation of ^{239}Np is applied. (auth)

48733 (JAERI–6004) DESCRIPTION AND HAZARD ANALYSIS OF JRR-3. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1968. 71p. (In Japanese). Dep.

Japan Research Reactor No. 3, the first Japan-made reactor, and its hazard analysis are described. It is a heterogeneous-type research reactor, with natural-uranium fuel rods, moderated and cooled by heavy water; the heat output is 10 MW and the thermal neutron flux $10^{13} n/cm^2 \cdot sec$. The reactor is designed with a multiple safety system to prevent accidents due to any misoperations; additional safety devices also are provided to contain hazards within its housing. Safeguard devices in the reactor environs assure no hazardous condition will exist in and around the reactor in the event of an accident. (auth) (NSA of Japan)

48734 (LA-DC–9638) DIGITAL CONTROL SYSTEM FOR THE UHTREX REACTOR. Demuth, Howard B.; Bergstein, Joe; Duerre, Kenneth H.; Schilling, Frederick P. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 21p. (CONF-680917–1). Dep. CFSTI.

From Seminar on the Application of On-Line Computers to Nuclear Reactors, Sandefjord, Norway.

An on-line computer has been included in a nuclear reactor system to aid in the operation of the reactor and the reactor coolant loops. The computer loads fuel; controls flow rates, temperatures in the coolant loops, and reactor thermal power; and performs a variety of monitoring and record keeping jobs. The computer central processor has 4,096 words of magnetic-core memory and 32,000 words of drum memory. The system can sample 608 analog and 576 digital inputs, and it can set 690 digital and 24 analog outputs. Twenty interrupt channels are used to allow time sharing of equipment and to initiate special programs dependent on conditions in the reactor system. The fuel loading program sequences valves, elevators, and rams through 73 operations in the loading of a single fuel element. The computer, using this program, has loaded some 2,000 fuel elements required for cold critical tests with complete success. The coolant flow control systems are completed and operate satisfactorily. All control programs include checks on transducer inputs, control equipment operation, and system stability. A number of other operational, equipmental, and programming features have been included in the computer system to enhance reliability. These features, combined in a computer that has proven to be highly reliable, give considerable assurance of proper system operation. (auth)

48735 (NP–17606) CRITICALITY OF THE LIQUID MIXTURES OF HIGHLY-ENRICHED UF_6 AND HF. Caizergues, Robert; Deilgat, Edouard; Lecorche, Pierre; Maubert, Louis; Revol, Henri (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr. 1968. 88p. (In French). (R–68.1). Dep.

Critical mass is determined for a UF_6-HF mixture as a function of ^{235}U concentration; the liquid-vapor equilibrium is established for the system. Schematics of the UF_6-HF circuit are shown; experimental apparatus is described. Density of the binary system is tabulated as a function of temperature; critical uranium concentration is shown as a function of temperature. Variation of the effective multiplication coefficient is shown as a function of sphere diameter. Effects of the wall of the sphere and temperature effects on the reactivity of the mixture are determined. 23 references. (M.L.S.)

48736 (ORNL–4254, pp 174-82) MOLTEN-SALT IRRADIATION EXPERIMENTS. (Oak Ridge National Lab., Tenn.).

ORNL RESEARCH REACTOR—experimental facilities for radiation performance of molten salt fuel, descriptions of in-pile loop

IN-PILE LOOP—configuration of ORR, for radiation performance of molten salt fuel

LITHIUM FLUORIDES, BERYLLIUM FLUORIDES, URANIUM FLUORIDES UF_4, ZIRCONIUM FLUORIDES—BeF_2–LiF–UF_4–ZrF_4, radiation effects on fission product penetration in graphite, analysis of

MOLYBDENUM ISOTOPES Mo-99, RUTHENIUM ISOTOPES Ru-103, TELLURIUM ISOTOPES Te-132, NIOBIUM ISOTOPES Nb-95, ZIRCONIUM ISOTOPES Zr-95, IODINE ISOTOPES I-131, BARIUM ISOTOPES Ba-140, STRONTIUM ISOTOPES Sr-89, YTTRIUM ISOTOPES Y-91, CESIUM ISOTOPES Cs-137, CERIUM ISOTOPES Ce-141, CERIUM ISOTOPES Ce-144, NEODYMIUM ISOTOPES Nd-147—fission

product activity in molten salt fuel in-pile loop, analysis of radiation effects on
SODIUM FLUOROBORATES — radiation effects on Molten Salt Breeder Reactor coolant, analysis of
GAMMA RADIATION — effects on coolant properties of sodium fluoroborate ($NaBF_4$), analysis of (D.C.C.)

48737 (SC-DR-68-501) ANNULAR CORE PULSE REACTOR (ACPR) PULSE BUILDUP TESTS. Rivard, J. B.; Hasenkamp, F. A. (Sandia Corp., Albuquerque, N. Mex.). Aug. 1968. Contract AT(29-1)-789. 35p. Dep. CFSTI.

A test program is described during which the Annular Core Pulse Reactor (ACPR) was brought to a performance level which produces a peak fuel temperature of 900°C, the planned initial operating limit. The test plan and the temperature analysis method are described, and detailed results of the tests are reported. (auth)

48738 RESEARCH REACTOR. Nakai, Yasushi (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1968-5639. Mar. 1, 1968. Filed Oct. 11, 1965.

A flat gas chamber is installed in the reactor, which floats on the surface of water, immersing the reactor core; the bottom of the chamber actually covers the whole surface. A means is provided for circulating air or helium gas, as is required, through the chamber. The coolant water is circulated by force through the reactor. (NSA of Japan)

48739 DEVICE FOR SEVERING AN IRRADIATED SAMPLE FROM ITS HOLDING ROD. Mazaki, Gengo (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1968-4919. Feb. 22, 1968. Filed May 8, 1964.

The device consists of the following: the massive shield through which the sample from the reactor core is removed; a hollow cylindrical rotor driven with a motor installed within the shield in the same axis as the path; cutting members which are set on a ring fixed on the circumference inside of the rotor and movable in the radial direction; springs to constantly press the cutting members away from the sample path; friction bodies installed at the cutting members which engage with the sample-holding rod; a means, installed in the rotor, for controlling the radial movement of cutting members; and, a means for preventing the rotation of a sample-holding rod within the shield. (NSA of Japan)

48740 DEVICE IN SAMPLE HOLDER FOR WINDING AND UNWINDING A MEASURING LEAD WIRE IN A HYDRAULIC-TUBE IRRADIATION FACILITY. Ouchi, Shinpei (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-10358. Apr. 30, 1968. Filed Mar. 31, 1965.

By the device proposed, the measuring lead wire attached to a sample within the holder can be wound around a bobbin in the holder when the sample is taken out of the reactor, and it can be unwound when the sample is sent into the reactor through a hydraulic tube. In the ordinary cylindrical sample holder in a hydraulic tube, through which water passes during its transport, rotating blades like those of a turbine are set at one end of the holder; and, a disc is attached on the axis of the blades at its outer end with a hole cut through the disc. A bobbin is installed within the holder enclosing the rotating blades within it. A measuring lead wire, introduced onto the bobbin through the hole in the rotating disc, can be wound or unwound by means of the rotation of the blades and hence of the disc which is operated by the water flow through the sample holder. (NSA of Japan)

48741 MEASUREMENT OF NEUTRON FLUX DISTRIBUTION IN A CELL OF A URANIUM–GRAPHITE REACTOR. Brighenti, G.; Giuliani, C.; Vigliano, E. P. (Univ., Bologna). Ing. Nucl., 9: No. 3, 19-23(May-June 1968). (In Italian).

Neutron flux measurements in the RB-1 reactor are discussed. The experimental apparatus is described; experiment locations are shown. Thermal flux profiles are shown graphically for a typical fuel element; cadmium ratio determinations are discussed. Error analyses associated with data collection and reduction are included. (M.L.S.)

48742 PRINCIPAL CONSTRUCTION AND EXPERIMENTAL PROGRAMS OF THE REACTOR ECO. Toselli, Franco (CCR-EURATOM, Ispra, Italy). Ing. Nucl., 9: No. 3, 11-18(May-June 1968). (In Italian).

Criteria for the dimensions of the zero power reactor ECO (Esperienza Critical Orgel) are outlined. Core, reflector, and shielding are described; cutaways are shown. Design characteristics of reference fuel elements are given. Hydraulic and auxiliary circuits are described; a schematic is shown. Control systems and instrumentation are described briefly. The proposed experimental program is outlined. (M.L.S.)

48743 STATIC AND DYNAMIC HYDROELASTIC INSTABILITIES IN MTR-TYPE FUEL ELEMENTS. PART I. INTRODUCTION AND EXPERIMENTAL INVESTIGATION. Smissaert, Georges E. (Pennsylvania State Univ., University Park). Nucl. Eng. Design, 7: 535-46(1968).

Hydroelastic instabilities that occur in MTR-type flat-plate fuel elements have been studied both experimentally and theoretically. The experimental part of the investigation, in which three mock-up plate assemblies were tested from the hydroelastic stability viewpoint, is described. A flow loop was built in which the three assemblies could be subjected to water flow rates, the maximum of which corresponded to 3.5 times the Miller's velocity of the assembly. The plates were instrumented with strain gauges, by means of which both static and dynamic deflection measurements could be made. In addition, it was possible to measure the static pressure profiles in three adjacent coolant channels. The experiments indicated that MTR-type fuel elements are subject to several hydroelastic instabilities. These instabilities were identified as: static divergence at the leading edge, static deformation in the plate array, a low-amplitude vibration in the form of traveling waves, and a high-amplitude vibration or flutter. A support comb across the leading edge of the plate assembly was found to remove the leading-edge static divergence and the flutter instabilities. (auth)

48744 TRANSIENT OF A PULSE REACTOR. Kawai, Toshio; Sumida, Isao (Hitachi Central Research Lab., Ozenji, Japan). J. Nucl. Sci. Technol. (Tokyo), 5: 383-6(Aug. 1968).

Power and temperature transients following a prompt critical pulse applied to an experimental reactor is studied by prompt jump approximation in two-dimensional phase space. The phenomena are classified into several types characterized by the amount of inserted reactivity and the value of cooling time constant. The temperature is shown to exceed in no case a level twice as high as the equilibrium value. (auth)

48745 DETERMINATION OF MATERIAL BUCKLING IN THE HELENA NATURAL URANIUM–GRAPHITE SUBCRITICAL ASSEMBLY. Dabrowski, Cyryl; Ivkovic, Magdalena; Mikulski, Andrzej; Sotic, Obrad; Zdravkovic, Zoran. Bull. Boris Kidric Inst. Nucl. Sci., Nucl. Eng., 19: No. 1, 1-12(Mar. 1968).

A detailed analysis of material buckling determination in graphite-moderated natural U subcritical assemblies has been made by the following methods: theoretical assumption of the neutron source condition and experimental determination of the relaxation length from the thermal neutron flux distribution along the vertical axis; experimental determination of the harmonic coefficients from the thermal neutron flux distribution in the horizontal plane, and the relaxation length from the vertical distribution; and experimental determination of the relaxation length from the thermal neutron flux measurements in the horizontal planes. Eight assemblies of various overall dimensions have been erected. All assemblies were made of graphite of 1.65 gr/cm^3 density and 2 ppM B purity. The characteristics of the assemblies are given. The results for material buckling by the above three methods are presented. (auth)

48746 NEUTRON DOSIMETRY STUDIES IN EBR-II. Jackson, J. L.; Ulseth, J. A. (Battelle Memorial Inst., Richland, Wash.). Nucl. Appl., 5: 275-82(1968).

Studies conducted in the EBR-II at 20 kW and at full power, 45 MW, confirmed the usefulness of threshold reactions, such as $^{54}Fe(n,p)^{54}Mn$ and $^{58}Ni(n,p)^{58}Co$, for fast-reactor dosimetry. Also, there are few neutrons (<1%) below 10^{-2} MeV in a fast reactor core, and the (n,γ) reactions, such as $^{63}Cu(n,\gamma)^{64}Cu$, become useful fast flux monitors. Eighty percent of the core neutrons can cause (n,γ) reactions while only 10% can cause (n,p) reactions. Results show that transport-theory calculations provide a good approximation to the spectrum in a fast reactor. Spectral-averaged cross sections for several EBR-II positions are presented. (auth)

48747 FISSION RATE MEASUREMENTS IN LOW POWER FAST CRITICAL ASSEMBLIES WITH SOLID-STATE TRACK RECORDERS. Roberts, James H.; Huang, Song-teh; Armani, Roland J.; Gold, Raymond (Northwestern Univ., Evanston, Ill.). Nucl. Appl., 5: 247-52(1968).

Solid-state track recorders (SSTR) of muscovite mica have provided absolute fission rates and fission ratios for ^{235}U and ^{238}U in ZPR-6, Assembly 5. The results agree well with diffusion theory and satisfactorily with radiochemical fission rate measurements. However, comparisons with fission chamber measurements reveal some differences, which can be attributed to the perturbing influence of the fission counter itself. Due to the high sensitivity of the SSTR method, measurements were readily extended into the blanket region of the assembly. Simplicity, reliability, and the wide sensitivity range make SSTR measurements an unusually powerful method for fission rate studies in low-power reactors. (auth)

48748 MICRO-ORGANISMS IN THE WATER CIRCUITS EXPOSED TO RADIATION OF THE NUCLEAR REACTOR BUDAPEST–CSILLEBERC. Hortobagyi, Tibor; Vigassy, Jozsef (Univ. of Agricultural Sciences, Godollo, Hungary). Acta Biol. Acad. Sci. Hung., 18: 151-60(1967).

The presence of living micro-organisms was demonstrated in the coolant water of the 2.5-MW Csilleberc research reactor. A description is given of the reactor coolant circuits and the levels of γ and neutron radiation in them. During operation, in the primary circuit very high radiation levels were reached, and, as a consequence of the neutron radiation of the water and the nitrogen and the salts dissolved in it, induced radioactivity was also present. The intensity of the neutron radiation was $\sim 10^{13}$ n/cm^2 sec, and of the γ radiation $\sim 2 \times 10^8$ R/hr. The specific activity of the primary water was $\sim 2.5 \times 10^{-7}$ Ci/l, and a 50-cm^3 sample gave a dose rate about 0.5 mR/hr, $1\frac{1}{2}$ days after removal from the reactor. In the secondary circuit the intensity of radiation was ~10 R/hr. Water was also sampled from the spent fuel tanks; it received $\sim 10^4$ R/hr of irradiation. Few micro-organisms were found in the primary circuit, where the water showed a radiation dose of 0.5 mR/hr. In this water a single species of blue alga, Romeria gracilis, was found. In the water of the burnt fuel element storage tanks and in the bottom sediments this blue alga also was found. In the secondary water circuit, in addition to the blue alga, a trichoma bacterium was observed as well as blue alga, Synechocystis minuscula, and the green alga of manifold form, Ankistrodesmus falcatus var. spirilliformis (Raphidium contortum). Of the 4 kinds of micro-organisms found, Romeria gracilis was the most radioresistant, occurring both in the active and inactive water. (BBB)

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Refer also to abstracts 47074, 47318, 47324, 47395, 47406, 47692, 48411, 48412, 48414, 48420, 48422, 48424, 48426, 48432.

48749 (AE-326) INVESTIGATION OF AN IRRADIATED FUEL PIN BY MEASUREMENT OF THE PRODUCTION OF FAST NEUTRONS IN A THERMAL COLUMN AND BY PILE OSCILLATION TECHNIQUE. Gustavsson, Veine (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1968. 23p. Dep.

A fuel pin irradiated to about 3400 MWd/tU from the Halden reactor was investigated by a measurement of the production of fast neutrons in a thermal column and by pile oscillator technique in the central channel of the reactor R-1. Calibration was made by using samples with different ^{238}U enrichments. The results from both the experiments were compared with values calculated by the REBUS code and the agreement was good. (auth) (Sweden)

48750 (DF-67-CAP-24) DESIGN CURVES FOR SPENT FUEL SHIELDING. Shultz, K. R.; Khor, P. A. (Canadian General Electric Co. Ltd., Peterborough (Ontario). Civilian Atomic Power Dept.). May 15, 1967. 137p. Dep.

Through slab shields of several common, single materials the γ dose rates were calculated for isotopic point and line sources of spent fuel. Results are shown as curves of: dose rate vs thickness, dose rate vs decay time, and integrated dose vs exposure time. For each material representative curves following reactor operation at unit power for 100 hr, 1000 hr and infinite hours are presented. Examples of application are given. (auth)

48751 (IFA-FR-68) METHOD FOR COLLAPSING FAST-REACTOR CROSS SECTIONS. Pavelescu, M.; Anton, V.; Purica, I. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 22p. Dep.

The critical size calculation of a fast reactor in a multigroup approximation is easier if the group number is small (1 to 4 group). This requires the microscopic cross sections averaged on the energy groups and weighted on the reactor spectrum. The spectrum has to be calculated, and if it is calculated in a middle group set (16 to 20 group) the avérage microscopic cross sections for a few group set can be determined. (auth)

48752 (KR-129) PIGG: A MULTIGROUP ONE-DIMENSIONAL P-1 CODE. Berg, J. O.; Fladmark, G. E.; Kulikowska, T.; Tverbakk, O. P. (Institutt for Atomenergi, Kjeller (Norway)). May 1968. 85p. Dep.

A complete description of the multigroup, one-dimensional P-1 code PIGG, coded in FORTRAN-63 for the CDC-3600 computer is presented. PIGG is in many respects similar to the PIMG-code, but some significant features are different. PIGG is intimately connected with the epithermal spectrum part of the BIGG II code and applies the same slowing down model, resonance absorption treatment, number of energy groups and epithermal cross section library. Up to six thermal energy groups may be used in PIGG, with precalculated group constants and scattering matrices as input. The PIGG input has been designed to permit both flexible and easy use of the code. The output is very extensive and includes a.o. pointwise group spectra and macrogroup constants, region-averaged macrogroup constants, and epithermal reaction rates for selected elements. (auth)

48753 (LA-DC-9838) ANALOG COMPUTER POTENTIOMETER RECORD AND STORAGE PROGRAM. Milich, Charles P. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 5p. (CONF-680816-1). Dep. CFSTI.

From Conference on Council for Advanced Programming, Las Vegas, Nev.

A system consisting of two EAI analog computers linked to a Honeywell DDP-116 digital computer for nuclear reactor simulation and control studies is described. The hardware and program designed to allow machine recording of addresses and values for each of the analog potentiometer settings are presented. (H.D.R.)

48754 METHOD FOR PRODUCING NUCLEAR FUEL PLATES. Nishijima, Toraji (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-10359. Apr. 30, 1968. Filed Feb. 10, 1965.

The method proposed has the following advantages: no need for prefabrication of the fuel meat; no fear for the separation of cladding and meat; and easy fabrication of fuel plates. A one-end closed cylindrical body of a metal with a small neutron-absorption cross section is packed with fuel powder. A plug is then inserted into the open end, and this part of the packed cylinder is sealed tight by press-melting while the interior space of the cylinder is evacuated. Finally, the packed and sealed cylinder is rolled to give the product fuel plate. (NSA of Japan)

48755 EARTHQUAKE-PROOF STRUCTURE OF A REACTOR. Fujita, Mototsugu (to Fuji Electric Mfg. Co., Ltd.). Japanese Patent 1968-8679. Apr. 3, 1968. Filed Aug. 30, 1965.

By the method proposed, the internal structure in a concrete pressure vessel can be supported suitably in the horizontal, radial direction. On the inside of the concrete pressure vessel, a ring is set circumferentially; this ring is divided circumferentially. On the outside of the cylindrical internal structure a ring is also fixed circumferentially, and in the outer circumferential edge of this ring horizontal groove cuts are made at the middle of the ring thickness; the ring itself is also divided circumferentially. The ring plate of the concrete pressure vessel fits into the groove cut to connect the pressure vessel to the structure. (NSA of Japan)

48756 DEVICE FOR SUPPORTING FUEL ELEMENTS IN THE FUEL ASSEMBLY. Iwai, Shozo (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1968-8676. Apr. 3, 1968. Filed Nov. 28, 1964.

A sort of supporting grid is set at both the top and bottom of a cylindrical body. Zigzagging plates are arranged across the open end of the cylindrical body so that a series of rhomb spaces is produced by the adjoining plates. The top or bottom of each fuel element is held at the joining points of the adjoining zigzagging plates; a means is provided to fix the top or bottom fast to the plates. (NSA of Japan)

48757 DEVICE FOR SENDING CAPSULES IN AN AUTOMATICAL MANNER. Nakai, Yasushi (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1968-4918. Feb. 22, 1968. Filed June 29, 1965.

The device proposed is for sending capsules containing samples to the reactor core or its vicinity for the purpose of measuring the neutron flux distribution. It consists of the following: a hopper where capsules are stacked; a rotating disk at a level below the hopper through which a number of holes are cut in a circle; a base plate with a hole just below the disc on the other side with respect to the position of the hopper; a path of a capsule to the reactor connecting to the hole in the base plate; and, a means for numbering a capsule in the hole of the rotating disc. One capsule after another from the hopper drops into the hole in the disc; as the disc rotates, the hole with the capsule fits in with the hole in the base; and then the capsule drops into the path leading to the reactor. (NSA of Japan)

48758 DEVICE FOR PREVENTING THE GAS LEAKAGE IN A REACTOR EXPERIMENTAL FACILITY. Mazaki, Gengo (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1968-7517. Mar. 21, 1968. Filed June 29, 1963.

The device consists of the following: an experimental facility installed in the experimental-hole shielding plug axially at the outer end of which a gas sealing chamber is formed by means of the outer membrane; a means for taking the facility out of the reactor which is connected air-tight to the experimental hole; a means for keeping the pressure within the chamber the same

as within the other part of the facility; and, a means for circulating a cooling air through the facility. When taking out the facility, the membrane is cut open after the connection to the experimental hole is complete; and, then the facility itself is taken into the "taking-out" means shielded-body. (NSA of Japan)

48759 PLUGGING TOOL. Amamiya, Shigeru (to Hitachi Ltd.). Japanese Patent 1967-24616. Nov. 27, 1967. Filed Sept. 8, 1965.

The plugging tool proposed is used to prevent the outflow of radioactive water from the reactor when the control-rod drive at the bottom is removed. For the plugging, a long, double-walled pipe is inserted from the top plate of the reactor through the reactor, the bottom end reaching to the hole. The end of the outer pipe is cut away in the form of an arc; the plug to fill the hole is attached rotatable at the same end of the inner pipe. The plug is manipulated from the other end of the long double-walled pipe by means of a handle. (NSA of Japan)

48760 SEALING ARRANGEMENTS. Woollatt, Harold David (to English Electric Co., Ltd.). British Patent 1,127,172. Sept. 11, 1968. Filed Jan. 21, 1965.

An arrangement is described for providing a seal between a member and a passage in which the member is longitudinally mounted. The member has a peripheral groove of T-shaped cross section with the narrow end outward. A ring of resilient sealing material is arranged to fit loosely in the groove, so that fluid pressure in the passage on one side of the ring forces a sealing engagement of the ring with the groove face and the wall of the passage. One application for the described sealing arrangement is in a standpipe closure for a gas-cooled reactor. (H.D.R.)

48761 IMPROVEMENTS RELATING TO PULSED NUCLEAR REACTORS. Hanke, Wilhelm (to EURATOM). British Patent 1,126,974. Sept. 11, 1968. Priority date Feb. 15, 1965, Germany.

A description of a pulsed nuclear reactor is presented. The reactor is pulsed by a rotating disc containing a portion of nuclear fuel or reflector material. The disc rotates before a neutron exit window. A safety arrangement to prevent the pulsing portion of the disc from stopping in front of the window is described. The disc has a screw connection with the drive shaft, and the screwthreads are co-axial with the axis of rotation of the drive shaft. A frangible driving connection in the form of a shear pin allows the disc to rotate out of the window position in the case of a drive shaft stoppage. (D.C.C.)

48762 AXIAL TEMPERATURE DISTRIBUTION IN A REACTOR COOLANT CHANNEL. Forghieri, R.; Papa, G. (CNEN, Bologna). Energ. Nucl. (Milan), 15: 571-7(Sept. 1968).

The dynamic response of a reactor coolant channel is investigated. The results include axially dependent coolant temperature and axially dependent fuel temperature at the wall. Analytic results are obtained by using the Laplace transform technique. (auth)

48763 OPTICAL SYSTEM FOR THE REMOTE POSITION-INDICATION OF A MOVING ELEMENT. Schwab, Bernard (to Commissariat a l'Energie Atomique). British Patent 1,125,356. Aug. 28, 1968. Priority date May 16, 1966, France.

A description of an optical system for the remote position-indication of a moving fuel element in a reactor vessel is presented. The optical system consists of a coding element synchronized with the fuel element movement, multiple parallel identification tracks, a fixed light source and a fixed light sensitive transducer separated by the identification tracks, and a selector having the same multiple tracks and which uncovers the tracks in succession. (D.C.C.)

48764 IMPROVEMENTS RELATING TO LOCATING ELONGATE HEAT EXCHANGE BODIES. Tutte, Edward; Anderton, Cyril (to United Kingdom Atomic Energy Authority). British Patent 1,125,901. Sept. 5, 1968. Filed May 25, 1965.

A description of a spacer grid of strips and wires for locating fuel elements in a multi-section core configuration for a nuclear reactor is presented. The core configuration consists of multiple fuel rods in a hexagonal lattice. (D.C.C.)

48765 APPARATUS FOR DETECTING FAILURES OF NUCLEAR FUEL ELEMENTS. (to Njhon Genshiryoku Kenkyu-Sho). British Patent 1,125,938. Sept. 5, 1968. Priority date Dec. 14, 1964, Japan.

A description of a dual column detecting system for fuel element failures in nuclear reactors is presented. The first column consists of a molecular sieve M.S.-13X and receives sample gases from the reactor interior. The second column consists of a molecular sieve M.S.-5A or activated charcoal and also receives sample gases from the reactor interior. (D.C.C.)

48766 SPECTRUM OF A MATRIX ARISING FROM A PROBLEM IN REACTOR KINETICS. Porsching, T. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). SIAM (Soc. Ind. Appl. Math), J. Appl. Math., 16: 301-17(Mar. 1968).

Properties of the spectrum of the composite matrix, utilized in the difference method solution to reactor kinetics equations, are derived. Definitions of the eigenvalues of the composite matrix are formulated. (TSS)

48767 A HYDRODYNAMICAL ANALYSIS FOR REACTOR PRIMARY CONTAINMENT BY ENERGY ABSORPTION. Sorensen, H. C. (Washington State Univ., Pullman); Fistedis, S. H. Nucl. Eng. Design, 7: 547-77(1968).

A hydrodynamical analysis of a nuclear accident is made for an idealized reactor vessel having spherical symmetry. The partial differential equations describing the fluid motion are based upon the Von Neumann–Richtmeyer artificial-viscosity technique and are presented in Lagrangian form. A numerical solution based upon finite-difference approximations of these partial differential equations is obtained for two idealized reactor systems: the reactor vessel considered as a thin membrane incapable of absorbing energy; the reactor vessel considered as an effective energy-absorbing device. The effect of the destructive component of the nuclear accident on the primary containment structure is determined. (auth)

48768 IMPROVEMENTS IN OR RELATING TO THE OPERATION OF NUCLEAR REACTORS. Marien, Pierre Jean Camille Albert (to United Kingdom Atomic Energy Authority). British Patent 1,126,322. Sept. 5, 1968. Filed Jan. 8, 1965.

A description of a reloading method for nuclear reactor is presented. The core configuration provides for coolant flow at right angles to the rows of the fuel elements. The reloading method consists of sandwiching rows of fresh fuel between rows of partially used fuel. (D.C.C.)

48769 NUCLEAR REACTOR FUEL ELEMENT AND METHOD OF MANUFACTURING SAME. (to Atomic Energy of Canada Ltd.). British Patent 1,126,396. Sept. 5, 1968. Priority date July 18, 1966, Canada.

A description of fuel fabrication methods for uranium ceramics and cermets is presented. The cylindrical fuel tube element has a central void space of 2 to 15% volume, an outer clad of Zircaloy-2, and an interlayer of Al–U. The fuel elements are slip-fitted and sealed by swaging the outer clad. (D.C.C.)

48770 IMPROVEMENTS IN AND RELATING TO COUPLING OF TUBULAR MEMBERS. Robinson, John Albert; Emsley, George Michael (to Nuclear Power Group Ltd.). British Patent 1,126,556. Sept. 5, 1968. Filed June 3, 1966.

A description of a coupling mechanism for multi-section tubular fuel elements for nuclear reactors is presented. The coupling mechanism consists of a flange on the inner end fitting, spaced slots on the outer end fitting, segmented locking members between the inner and outer end fittings that engage the spaced slots, and a spring-supported retaining ring. (D.C.C.)

48771 LOCATING STRUCTURE. Forrest, John Alan; Jackson, George Oliver (to United Kingdom Atomic Energy Authority). British Patent 1,126,733. Sept. 11, 1968. Filed Dec. 23, 1964.

A description of a core support grid for a nuclear reactor is presented. The support grid consists of multiple layers of parallel vertical-edge strips. The layers are interconnected in three different directions to form hexagonal lattice structure for multiple parallel rod-type fuel elements. (D.C.C.)

48772 ABSORBER ROD FOR NUCLEAR REACTORS. (to Licentia Patent-Verwaltungs-GmbH). British Patent 1,126,218. Sept. 5, 1968. Priority date Dec. 7, 1964, Germany.

A description of a nuclear reactor control rod is presented. The control rod consists of boron steel absorber material hermetically sealed in stainless steel support plates. The control rod is cross-shaped in cross-section and consists of multiple spring-braced triangular plates. (D.C.C.)

48773 FUEL ELEMENT SUPPORT GRID. (to Combustion Engineering, Inc.). British Patent 1,125,982. Sept. 5, 1968. Priority date Sept. 21, 1965, United States.

A description of a support grid for spacing and supporting a bundle of multiple parallel fuel elements is presented. The grid consists of multiple members which intersect and form multiple four-sided parallel compartments. Two adjacent sides of each compartment are partially severed from the grid members and are bent toward the fuel elements to form stiff spring bracings. (D.C.C.)

48774 MANUFACTURE OF RADIO-ISOTOPES. Bodnarescu, Musat V. (to EURATOM). U. S. Patent 3,396,077. Aug. 6, 1968. Priority date Oct. 18, 1963, Belgium.

An irradiation capsule for use in a control rod of a nuclear reactor for the production of radioisotopes in epithermal and fast neutrons is described. The capsule comprises an outer tubular shield in which a target material is enclosed, the shield being closed at the ends thereof by stoppers. The lower stopper is provided with spacing members to center the capsule within the control rod and have them rest on a shoulder formed at the lower end of the control rod. These spacing members are retractable within the periphery of the lower stopper to allow removal of the capsule from the control rods. A pair of telescopic tubes are provided at the top of the capsule, the lower tube being secured to the upper stopper and the upper tube being provided with laterally projecting spacers intended to be pressed against a shoulder at the upper end of the control rod by means of a spring cooperatively mounted on the two telescopic tubes to move them away from one another. (Offic. Gaz.)

48775 THE DEVELOPMENT OF THE PRESTRESSED NUCLEAR REACTOR VESSEL CONCEPT IN EUROPE AND THE UNITED STATES. Germain, P. (Societe d'Etudes et d'Equipments d'Enterprises, Paris). J. Prestressed Concrete Inst., 12: 43-51(Aug. 1967).

The use of prestressed concrete containment vessels for various types of nuclear reactor installations is reviewed, with emphasis on differences in United States and European approaches. Some problems considered in the design of such vessels are: more sophisticated design of the tendon pattern, which requires rigid ducts, in order to develop a very low friction coefficient; secondary stresses due to the curve of the tendons; function and efficiency of the gastight skin; preventive measures against corrosion of the tendons; the dilemma of whether to use grouted tendons or greased tendons; theoretical and practical possibilities for removing the tendons, checking, and replacing or changing them; allowable strength permitted in various cases for concrete under stress; and possibilities of cracking under certain loads. Advantages and disadvantages of prestressed concrete vs steel are considered. (BBB)

48776 THERMOELASTIC BOWING OF COMPOSITE CYLINDRICAL FUEL RODS. Hunter, Brook L. (General Electric Co., Schenectady, N. Y.); Yu, Yi-yuan. Nucl. Eng. Design, 7: 487-502(1968).

The thermoelastic bowing of axially unrestrained nuclear fuel rods due to a transversely linear internal heat generation rate is investigated. The problem consists of first determining the steady-state, two dimensional temperature distribution in the circular cross section of the rod and then solving for the corresponding stresses and displacements. The thermoelastic problem is solved with the aid of the Airy stress function. For constant material properties the problem is solved exactly. For temperature-dependent material properties, an approximate method is used, with the fuel rod replaced by a number of concentric layers, each assumed to have constant material properties. Solution given by the approximate method is in the form of the infinite series. The axial stress produces a resultant moment when integrated over the cross section of the rod. Two numerical examples are solved. In the first a rod with constant properties is analyzed by both the exact and the approximate methods. The excellent agreement between the results serves to determine the validity of the approximate method. The second numerical example deals with a rod with typical variable material properties, which can be analyzed only by the approximate method. (auth)

48777 AN EXPERIMENTAL STUDY OF SPRAY COOLING IN NUCLEAR REACTOR CONTAINERS. Sagawa, Norihiko (Hitachi Ltd., Japan). J. Nucl. Sci. Technol. (Tokyo), 5: 419-26(Aug. 1968).

As a contribution to the safety analyses of condition following loss-of-coolant accidents in light water reactor, experiments were performed to obtain data on container spraying and on accompanying heat transfer characteristics, by means of a one-tenth scale model container. The loss of coolant was simulated injecting high temperature saturated water into the model container in which air had been enclosed at atmospheric and room temperature, and then the steam-air mixture was cooled by sprays of water. The rate of heat absorption by the spray was obtained from both stationary and transient data, and it was confirmed that the absorption becomes incomplete as the container pressure is lowered. The evaporation of the water collected at the bottom and of that from sprayed walls of the container was derived from container pressure variation in time, by measuring its rate of change immediately following stoppage of the spray; the rate of evaporation was found more active as the rate of spray cooling increases. The evaporation from the sprayed walls was obtained from thermal data taken on a copper cylinder placed in the container, and it was found that the evaporation becomes more active as the pressure increases. (auth)

48778 QUADRUPOLE THEORY AND TRANSMISSION MATRIX METHOD IN REACTOR CALCULATION. Nuding, E.; Warmbold, I. (Siemens Aktiengesellschaft, Erlangen, Ger.). Z. Angew. Math. Mech., 47: T69-72(1967). (In German).

Two known computer methods for reactor physics calculations were compared with each other. The transmission matrix method was shown to be valid, but the transition matrix method was shown to be inaccurate. In both methods the same initial equations (the one dimensional neutron diffusion equations in Cartesian coordinates) and the same material constants were resolved by making the thick m-zone reactor critical by variation of the dimension $\alpha \rightarrow \alpha_{crit}$. (J.S.R.)

48779 SHEATHED FUEL ELEMENTS FOR NUCLEAR REACTORS. Dodd, John Alan (to United Kingdom Atomic Energy Authority). U. S. Patent 3,399,112. Aug. 27, 1968. Priority date May 26, 1966, Great Britain.

A fuel element for a nuclear reactor has a vent path for the removal of the gases released from the fuel in service. This vent path comprises an extension of the fuel element sheath. This extension is enshrouded by a hood to form a diving bell gas trap. Situated in this diving bell gas trap is a non-return valve in the form of a metallic cup closure having a lip. The lip opposes flow towards the fuel but allows flow in the opposite direction. (Offic. Gaz.)

48780 SUPPORT GRID STRUCTURE FOR A NUCLEAR FUEL ASSEMBLY. Voigt, Otfried; Hoechel, Jochen (to Licentia Patentverwaltungs-GmbH). U. S. Patent 3,369,973. Feb. 20, 1968. Priority date Dec. 7, 1964, Germany.

A fuel rod holding and positioning unit is described for holding multiple fuel rods in proper spaced relation in a reactor core. The unit consists of: a substantially flat frame; and a plurality of resilient wires arranged to form a matrix for receiving the fuel rods and each having its ends connected to the frame. Each of the wires has a zigzag shape which causes the wire to have multiple contacting points extending transversely to a line joining the ends of the wire and to a reference plane extending parallel to the median plane of the frame. (Offic. Gaz.)

48781 NUCLEAR REACTOR FUEL ELEMENT WITH ATTACHED THERMOCOUPLE. Seymour, Stanley Charles (to English Electric Co., Ltd.). U. S. Patent 3,369,972. Feb. 20, 1968. Priority date Jan. 22, 1965, Great Britain.

A description of a fuel element-connected thermocouple is presented. The fuel element includes a metallic can with radial splitter fins. The thermocouple hot junction is attached to a fin with the cable passing along the assembly to a prescribed location. To remove the thermocouple cable, tension is applied until the cable snaps at the middle point on a free loop section. Guide plates with narrowing separation are attached to a fin and straighten the cable as it is being withdrawn. (D.C.C.)

48782 APPARATUS FOR CONTROLLING A NUCLEAR REACTOR PLANT. Kaegi, Jakob (to Sulzer Brothers, Ltd.). U. S. Patent 3,369,971. Feb. 20, 1968. Priority date Oct. 30, 1963, Switzerland.

A description of a flow control unit for a heat transfer system of a nuclear reactor is presented. Dual piston-actuated temperature sensors serve to regulate valve openings for primary coolant flow and secondary superheat coolant flow. The two valve regulating devices are interconnected. (D.C.C.)

48783 CONTROL ROD DRIVING SYSTEMS FOR NUCLEAR REACTORS. Hanson, Douglas Oliver; Ingham, Robert Vincent (to Nuclear Power Group Ltd.). British Patent 1,127,390. Sept. 18, 1968. Filed May 24, 1966.

A control rod driving system for a nuclear reactor is described. The system regulates multiple interconnected control rod drives. Each control rod is suspended by a flexible member which is wound on a drum or pulley. The system functions automatically and continuously. Each control rod is driven by an induction motor operating at mains frequency through an electromagnetic clutch and speed reduction gearing. A fixed potentiometer with a rod-moving wiper serves as a position monitor for each control rod. (D.C.C.)

48784 AN ARRANGEMENT FOR MONITORING THE POSITION OF A MOVABLE MEMBER WITH RESPECT TO A FIXED MEMBER. Aubert, Michel; Fortin, Guillaume (to Commissariat a l'Energie Atomique). British Patent 1,128,426. Sept. 25, 1968. Priority date July 18, 1966, France.

A description of a position monitoring device for a reactor loading machine is presented. The monitoring device consists of multiple electromagnetic exciter coils arranged in a row on one of the members. Multiple rows of varying number receiving coils are arranged on the other member extending in a transverse direction. Alternating current at varying frequencies is fed into the exciter coils. By analyzing the induced currents from the receiving coils the position of the moving member is determined. (D.C.C.)

48785 SPACER FOR BOX-SHAPED NUCLEAR FUEL ELEMENT. Huber, Gerald; Kroepfl, Hans (to Siemens Aktiegesellschaft). U. S. Patent 3,398,053. Aug. 20, 1968. Priority date Sept. 3, 1965, Germany.

Spacers are described of fuel rods received in a respective mesh defined by intersecting crosspieces of structural material in a lattice frame. With a perforated outer wall of structural material, a box-shaped nuclear fuel assembly is formed including two rigid structural elements and a loose, resilient structural element located in each mesh. (Offic. Gaz.)

48786 NUCLEAR FUEL ELEMENT. Jeitner, Franz; Reinhart, Karl; Semmler, Juergen (to Arbeitsgemeinschaft Versuchs-Reaktor AVR GmbH). U. S. Patent 3,398,052. Aug. 20, 1968. Priority date Feb. 12, 1965, Germany.

A spherical nuclear reactor fuel element is described. The spherical body of moderator material has an inner hollow of rounded shape concentric to the spherical surface for receiving nuclear fuel. An insert rod of moderator material is disposed in the hollow. The rod has a longitudinal axis and a surface symmetrical with respect to the axis and forms with the spherical body a ring-shaped interspace also symmetrical with respect to the axis. (Offic. Gaz.)

48787 SPECIAL FABRICATION TECHNIQUES. Reactor Mater., 11: 191-203(Fall 1968).

The ductile-to-brittle transition-temperature comparisons for Re–W are presented. The general process for extrusion and drawing of W and W-alloy tubing is described. Ion plating methods are discussed. Casting and hot-press bonding methods are also discussed. Welding property studies for Inconel 718 are presented. The tensile properties of Ta and Nb welded sheets are listed. Tensile properties of Inconel 625 are presented. 65 references are included. (D.C.C.)

48788 CLADDING AND STRUCTURAL MATERIALS. Reactor Mater., 11: 164-90(Fall 1968).

The oxidation behavior of Nb–Zr is analyzed. The corrosion behavior of Cr–Fe–Sn–Zr is described. The oxide formation and deposition on carbon steels and stainless steels in high-temperature water is discussed. The oxidation behavior of Ta at 500 to 625°C after anodizing in H_3PO_4 is described. Biaxial stress-rupture data for Type 304 stainless steel is presented. The stress-rupture behaviors of Incoloy 800 and Cr–Ni–steel at 700°C in contact with Na and air are plotted graphically. Cavitation damage is analyzed for Stellite 6B, L-605, and Type 316 stainless steel in 800°F Na. The effects of liquid Li at 1000°C on the tensile properties of Nb–W, Nb–W–Zr, and Mo–Nb–W–Zr alloys are presented. Radiation effects on the tensile properties of Type 304 and Type 348 stainless steels are analyzed. The effects of radiation on the ductile properties of Type 316 stainless steel in 600°C liquid Na environment are presented. The effect of boron and carbon content on postirradiation elongation of Cr–Ni–stainless steel at 750°C is plotted graphically. The effect of helium on the stress-rupture ductility of Type 304 and modified Type 304L stainless steels irradiated at 50°C is described. The stress-rupture properties of irradiated and unirradiated Incoloy 800 at 705°C and Hastelloy X at 650°C are presented. The tensile properties of Hastelloy X-280 and Inconel 600 at 1350°F are listed. Neutron radiations and temperature effects on tangential rupture strength of Cr–Ti–V are described. Radiation effects on the tensile properties of Nb are presented. The effects of stress and atmosphere on the creep rates of Magnox Zr-55 at various temperatures are analyzed. Analysis of hydride orientations for Zircaloy fabrication processes is presented. Tensile properties of Cr–Nb–Zr alloy are described. The effects of fast neutrons on gross volume increase of NbC, TaC, ZrC, TiC, and WC are discussed. The phase diagram for Nd_2O_3–PdO at 700 to 1400°C is presented. 121 references are included. (D.C.C.)

48789 MODERATOR AND CONTROL MATERIALS. Reactor Mater., 11: 157-63(Fall 1968).

The elastic constants of pyrolytic graphite and the shear modulus of natural graphite crystals are presented. The mechanical properties of S-200 beryllium cross-rolled sheet are listed. Alloying techniques for Be–Cu and Al–Be (Lockalloy) are described. The phase diagram for H–U at 400 to 850°C is presented. The terminal solubilities of hydrogen in zirconium, Zircaloy-2, and Zircaloy-4 are analyzed and graphically plotted. 29 references are included. (D.C.C.)

48790 FUEL AND FERTILE MATERIALS. Reactor Mater., 11: 145-56(Fall 1968).

The diffusion of U in Ti and Fe is described. Creep-rupture mechanisms of U are analyzed. Phase diagrams for Ru–U, Rh–U, and Ir–U are presented. Mechanical and physical properties of high-purity cast U are listed. Tensile properties of Mo–U are presented. The solubility of Pu in Fe is analyzed. The thermal diffusivities of UC, PuC–UC, and PuC from 500 to 1500°C are listed. The thermal conductivities of varying stoichiometry UO_2 and PuO_2–UO_2 are presented. Lattice diffusion coefficients of Pu in sintered ThO_2 and ThO_2–UO_2 are described. The general phase diagrams for C–N–U systems at 1500 to 1800°C and N–Th–U systems at 1000°C are presented. 66 references are included. (D.C.C.)

48791 REACTOR MATERIALS. Volume 11, Number 3. Simons, E. M.; Porembka, S. W. Jr.; Keller, D. L. (eds.). One of Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Columbus, Ohio, Battelle Memorial Institute, Fall 1968. 60p. GPO $0.70.

Separate abstracts are included for all four of the sections presented. (D.C.C.)

For abstracts of individual sections see: 48787–48790.

48792 BOUNDARY-LAYER DIFFUSION MODEL OF FISSION PRODUCT RELEASE FROM REACTOR FUELS. Miller, C. E. Jr. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 5: 198-205(1968).

A mathematical model that predicts the extent of fission product release and fuel evaporation during a loss-of-coolant accident has been developed for a specific set of conditions. Theories of boundary-layer diffusion have been applied. Related in the model are the amount of fission product and fuel released, the composition and pressure of the cover gas, the temperature, surface area, and amount of molten fuel, the time molten, and the chemical forms of the fission products and fuel. (auth)

48793 NUCLEAR REACTOR CONTROL ROD. Depuy, Gerard; Germond, Philippe (to Commissariat a l'Energie Atomique). British Patent 1,128,589. Sept. 25, 1968. Priority date Sept. 16, 1966, France.

A description of a control element for a nuclear reactor with a core of multiple fuel elements is presented. The control element consists of a square cross-sectioned tubular casing with inner and outer walls. The control element surrounds the fuel element assembly. The inner and outer walls of the tubular casing contain multiple coolant holes and support multiple cobalt plates. (D.C.C.)

48794 NUCLEAR REACTOR HANDLING DEVICE. Boulinier, Claude; Branchu, Joel; Chemin, Paul; Dupuy, Gerard; Malaval, Claude (to Commissariat a l'Energie Atomique). British Patent 1,128,396. Sept. 25, 1968. Priority date July 13, 1965, France.

A loading machine for a liquid-cooled reactor is described. The loading machine consists of a rotating drum mounted in a shielded unit which is sealed to the reactor vessel. A gripping device draws fuel elements from the reactor into the drum. Fuel elements are then transferred to individual liquid-cooled containers inside the shielded unit. (D.C.C.)

48795 IMPROVEMENTS IN OR RELATING TO THE CONTROL OF NUCLEAR REACTORS. (to Skoda, Narodni Podnik). British Patent 1,128,066. Sept. 25, 1968. Priority date Jan. 3, 1965, Czechoslovakia.

A description of a nuclear reactor control element is presented. The control element is designed for liquid-moderated reactors with multiple spaced vertical fuel elements. The control element consists of a grid which fits over the fuel rods at right angles. The control element moves in an up-and-down configuration for regulating the reactor. (D.C.C.)

48796 FUEL SUPPLY AND FUEL CYCLES. Nentwich, Alfred A. Elektrotech. Maschinenbau, 85: 238-50(May 1968). (In German).

Supplies of nuclear fuels, specifically U, in the western world are reviewed. Cycling of fuels for enriched U is broken down into preparation of yellow cake, conversion to UF_6, and enrichment by gas diffusion. Analysis of costs is discussed, particularly with respect to going on line as a function of fuel prices. Several alternatives are suggested for the procurement of fuels. (BBB)

48797 FUEL SERVICES OF THE UKAEA FOR NUCLEAR ENERGY. Manning, R. B. Elektrotech. Maschinenbau, 85: 252-4(May 1968). (In German).

The U. K. Atomic Energy Authority not only meets requirements of the British nuclear power enterprise, but also has a fuel service for foreign reactors. The enrichment plant at Capenhurst is increasing its throughput to 600 tons U/year with 5% enrichment in the middle of the 70's. Workup of U and fuel preparation is also available; Magnox fuels reach a value of 1500 tons fuel/year; oxide fuels will be produced at 400 tons/yr in the 70's and reach over 1000 tons/yr by 1980. A plant for the preparation of UO_2 elements in Zircaloy cans is at hand. Reprocessing plants will be able to supply 100 tons/yr of irradiated enriched oxide by 1973 and 700 tons in 1980; capacity is excessive for foreign reactor fuel reprocessing. Transport and guarantees are described, and handling of recovered Pu is proposed. (BBB)

48798 RIGGING NUCLEAR VESSELS. Ewbank, Casey (Reliance Truck Co., Phoenix, Ariz.). Power Eng., 71: 46-7(Oct. 1967).

Special equipment and engineering knowledge necessary in the installation of nuclear reactor pressure vessels are discussed. Transport of the Oyster Creek vessel to the plant and its installation are described in detail and illustrated. (BBB)

48799 VARIATIONAL MULTICHANNEL SPACE–TIME SYNTHESIS METHOD FOR NONSEPARABLE REACTOR TRANSIENTS. Stacey, Weston M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucl. Sci. Eng., 34: 45-56(Oct. 1968).

A multichannel space–time synthesis model for the calculation of nonseparable reactor transients is developed from a variational functional which admits expansion functions that are discontinuous in space and time. In each of many spatial regions, the flux during each interval of time is expanded in known functions of position with unknown expansion coefficients. The accuracy of the method, and its superiority with respect to the conventional single-channel space–time synthesis method, are demonstrated by several numerical examples. 22 references. (auth)

48800 GEOMETRIC BUCKLING OF POLYGONAL REACTORS. Murray, Raymond L.; Hirons, Thomas J.; Reith, Raymond J.; Smith, Owen J. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng., 34: 86-7(Oct. 1968).

A solution to the cylindrical coordinates form of the Helmholtz equation is obtained. Boundary conditions for a reactor core with a regular polygonal cross section, when applied to the Helmholtz equation solution, allow determination of approximate values for the buckling. Data are tabulated. (M.L.S.)

48801 POSITIVITY THEOREMS FOR THE DISCRETE FORM OF THE MULTIGROUP DIFFUSION EQUATIONS. Froehlich, Reimar (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Sci. Eng., 34: 57-66(Oct. 1966).

The existence of a unique positive critical flux distribution and of a corresponding single positive eigenvalue (k-effective), which is greater than the absolute value of any other eigenvalue, is established for the discrete form of the steady-state multigroup diffusion equations. The assumptions here are considerably less restrictive than formerly used. For example, arbitrary scattering matrices, general fission transfer matrices, and internal nondiffusion regions are allowed. Furthermore, the transitivity assumption of the problem is replaced by weak conditions of connectedness, which are not only sufficient but also necessary for the existence statements. The theoretical and computational significance of the existence and positivity theorems are discussed. Several examples illustrate the generality of the results and the importance of the conditions of connectedness. 16 references. (auth)

48802 NUMERICAL COMPARISON OF DIFFUSION-LIKE TRANSPORT APPROXIMATIONS FOR VERY FAST NEUTRONS. Freeman, L. B.; Ryals, H. W. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng., 34: 67-75(Oct. 1968). (WAPD-T-2061).

The simplified-P_1(SP_1) and modified-P_2(MP_2) transport approximations have been considered for use as practical nuclear design tools, replacing diffusion theory in the first few-group of a four-group scheme. Two numerical comparisons of two-dimensional systems indicate that SP_1 can be a satisfactory design tool for situations where the total cross section is slowly varying and the geometry is not too severe. The MP_2 approximation has certain computing advantages, but does not yield as uniform an improvement over P_1 as SP_1 does. 14 references. (auth)

48803 NEW DERIVATION OF DISCRETE ORDINATE APPROXIMATIONS. Kaplan, Stanley (Univ. of Southern California, Los Angeles). Nucl. Sci. Eng., 34: 76-82(Oct. 1968).

It is shown that the idea of space-angle synthesis may be used to provide a new framework for the derivation of discrete ordinate methods. It is also shown that within this framework one can cleanly and systematically incorporate various stratagems aimed at overcoming the ray effects that plague discrete ordinate methods in two- and three-dimensional problems. 13 references. (auth)

GENERAL

48804 (AWRE-O-41/68) MAP, TIME SERIES, AND OTHER PLOTTING ROUTINES FOR USE WITH THE STROMBERG-CARLSON 4020 PLOTTER. Young, J. B.; Douglas, A. (Atomic Weapons Research Establishment, Aldermaston (England)). July 1968. 76p. Dep. CFSTI. UK 11s. 0d.

Six plotting packages for use with the SC4020 plotter with the IBM 7030 computer are described. Three of the packages are for plotting maps, two for plotting time series and one for general cartesian co-ordinate graphs. A routine for drawing dotted lines is also described. (auth)

48805 (DP-929(Rev.1)) PUBLICATIONS, 1951 THROUGH 1967. Hilborn, H. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). July 1968. Contract AT-(07-2)-1. 209p. Dep. CFSTI.

A compilation of research and development reports, journal articles, contributions to books, computer programs, and other items published by DuPont under its contract with the AEC is presented. Bibliographic, subject, and author listings are included. (W.H.K.)

48806 (IA-1168) RESEARCH LABORATORIES ANNUAL REPORT, JANUARY-DECEMBER 1967. (Israel Atomic Energy Commission, Tel Aviv). Apr. 1968. 256p. Dep.

Brief summaries are presented of the research work carried out during the period January-December, 1967. (auth)

48807 (PRNC-121) PUERTO RICO NUCLEAR CENTER ANNUAL REPORT, 1967. (Puerto Rico Nuclear Center, Mayaguez). Contract AT(40-1)-1833. 289p. Dep. CFSTI.

Summaries are given of the education and training programs, biological and medical research programs, which include work in marine biology, terrestrial ecology, radiation chemistry, parasitology, and entomology, and physical research in neutron diffraction, solid state physics, and hot-atom chemistry. A preliminary study on the effects of mining with nuclear explosives is reviewed and research on radiation preservation of various tropical foodstuffs is outlined. (C.E.S.)

48808 (SC-CR-67-2630) RESPONSE OF A THIN-WALLED, SHORT CLOSED CYLINDER TO AN ARBITRARY MOVING PRESSURE WAVE OF SHORT TIME DURATION. Hultgren, Ronald O. (Virginia Univ., Charlottesville). Aug. 1967. 119p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex. Thesis.

An analysis of the dynamic deformation and stress characteristics of a thin-walled, short cylinder acted on by a moving pressure wave of short duration is presented. It includes the effects of large radial deflections, plasticity of the cross section, kinematic strain hardening, and longitudinal and circumferential stiffeners in the cylinder. The cylinder wall is idealized by three distinct layers, and a bilinear stress strain curve is assumed for the wall material. The Tresca yield condition and its accompanying constitutive equations are used. Fourteen first-order nonlinear partial differential equations are developed to determine the displacements, the rotations, and the forces at a finite number of points of the cylinder wall. The equations are reduced to finite difference form, and the solution method is indicated in matrix notation. In this analysis the orientation of the cylinder to the pressure wave is arbitrary. (auth)

48809 (UCRL-50414) RIBOSOMES AND RIBOSOMAL RNA: ISOLATION BY A RAPID METHOD. Watchmaker, G.; Timourian, H. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 12, 1968. 5p. Dep. CFSTI.

A method for the isolation of ribosomal particles and ribosomal RNA is described. By taking advantage of zonal ultracentrifugation and ultrafiltration with selective membranes, the repeated precipitations and resuspensions that usually result in the loss of material were avoided. (auth)